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The Probable Incidence and Clinical Features of "Virus" Pneumonia[1]

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THERE CAN BE NO doubt that an unusual type of atypical primary bronchopneumonia has become much more prevalent in widely separated districts of the United States in the past two years. Many good clinical descriptions of the outbreaks of the disease, which has been given a variety of names, are quite similar in all of their essential features. While the term "virus pneumonia" seems justified on the basis of several excellent studies, we have no knowledge of the number of viruses involved. Few clinicians have the facilities for determining whether or not a virus is present at all. Hence, in the present state of our knowledge, it is probably wiser to use the term "primary atypical bronchopneumonia, etiology undetermined" in describing the pneumonias which apparently fall into this group, as recommended by the War Department (1). Other names by which the disease has been called are: acute influenza pneumonitis (Bowen, 2); acute pneumonitis (Allen, 3); disseminated focal pneumonia (Scadding, 4); atypical pneumonia (Reimann, 5); benign bronchopulmonary inflammation (Ramsay and Scadding, 6); acute diffuse bronchiolitis (McKinlay, 7); acute interstitial pneumonitis (Smiley, Showacre, Lee, and Ferris, 8); atypical bronchopneumonia with leukopenia (Maxfield, 9); bronchopneumonia of unknown etiology, variety X (Longcope, 10); Q fever (Dyer, Topping, and Bengston, 11); primary virus pneumonitis (Adams, Green, Evans, and Beach, 12).

It is manifestly impossible to know how many cases of this disease are occurring in all communities, since most cases not proved to be pneumococcus pneumonia are not reported to state health departments, and among those of uncertain etiology, as explained above, it is impossible to determine with certainty how many are "virus" pneumonias. Since August 1941, in addition to the 31 cases of primary atypical bronchopneumonia reported in this communication, I have seen fully one-half that many patients in whom no pneumococci could be found, but in whom *all* the clinical criteria for a diagnosis of probable "virus" pneumonia were not present. During this period, only 8 cases of proved pneumococcus pneumonia have been seen. In conversation with my colleagues, I find that their experience has been similar—that is, that primary atypical bronchopneumonias of undetermined etiology outnumber proved pneumococcus pneumonias by about four to one.

[1] From the Department of Medicine, Northwestern University Medical School, and Wesley Memorial Hospital, Chicago. Presented, as part of a Symposium on Atypical Pneumonia, before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

TABLE I: AGENTS ISOLATED FROM PRIMARY ATYPICAL BRONCHOPNEUMONIA

Authors	Laboratory Animals	Antigenic Relationships
Francis and Magill (13)	Ferrets	
Stokes, Kenney, and Shaw (14)	Ferrets and mice	Resembled in some respect viruses of lymphocytic choriomeningitis, lymphogranuloma inguinale, psittacosis, Theiler's encephalomyelitis of mice
Weir and Horsfall (15)	Mongooses	
Eaton, Beck, and Pearson (16) Eaton, Martin, and Beck (17) Rake, Eaton, and Shaffer (18)	Mice	Resembled in some respects Francis and Magill's meningopneumonitis strains, psittacosis, lymphogranuloma venereum
Dyer, Topping, and Bengston (11)	Guinea-pigs and mice	Rickettsia
Stickney and Heilman (19)	Mice	Resembled in some respects viruses of psittacosis (Meyer) and meningopneumonitis (Francis and Magill)

ETIOLOGY

Table I illustrates the present state of confusion as to the etiology of this condition. As will be noted, Francis and Magill (13) in 1938 isolated a virus which apparently is related to the disease, and its close relationship to the viruses of lymphogranuloma venereum and psittacosis has been shown. Weir and Horsfall (15) isolated a virus in a number of cases and with it obtained quite typical changes in the lungs of mongooses. The disease thus produced could be transmitted easily from one mongoose to another. These investigators did not describe a relationship to the other viruses mentioned. An excellent review of the work on establishing the etiology of these atypical pneumonias is given by Reimann, Havens, and Price (20).

Our own etiologic studies are incomplete. However, from the sputum of one patient, whose clinical record will be described later (Case 6), Dr. Mary Ray, Jane Noble, and I have obtained material which appears to produce typical changes in the mouse lung. In accord with the suggestions of Eaton and his co-workers (16–18) the sputum was ground up in sterile broth and, in the unfiltered state, dropped into the nostrils of a lightly anesthetized mouse. After five days, the lungs of this mouse were removed aseptically and ground up with sterile broth in a mortar containing sterile sand. A second mouse was inoculated with this material, which was found by culture to contain *Streptococcus viridans*. After five days, the second animal was sacrificed and its lungs were ground up and inoculated into a third mouse. At this time, microscopic sections of the lungs were showing small areas of bronchopneumonia. After eight such passages, the ground-up lung suspension in broth was filtered. The next mice were inoculated intranasally with both filtered and unfiltered material. After two such passages, the filtrate produced in the inoculated mouse numerous areas of bronchopneumonia, unassociated with large numbers of polynuclear cells in the alveoli. This finding does not establish the presence of a virus in this material, because inclusion bodies were not seen, and neutralization tests have not been made. It is, however, of interest. The most extreme pneumonitis was produced by the unfiltered material containing *Streptococcus viridans*. It is significant that the inoculating material containing *Streptococcus viridans* plus the possible virus produces much more severe and extensive changes than the filtered material alone. This finding may throw some light on the very severe cases of "virus" pneumonia which have a more stormy course than the majority of cases seen during the same period. Most of these cases show a leukocytosis and may have bacterial infection complicating the virus infection.

CLINICAL DATA

As stated above, many good clinical descriptions of this disease are now available (1, 2, 21, 22, 23, 24). My own experience is with 31 cases observed between August 1941 and December 1942. Twenty-

four of the 31 patients were hospitalized. The results of roentgenological and laboratory examinations to be given below are from the hospitalized group. Roentgenograms were made on all of these.

Summary of Clinical Data
Total cases, 31
Sex incidence
  Females 17
  Males 14
Age
  10–20 years, 6 cases
  20–30 years, 5 cases
  30–40 years, 9 cases
  40–50 years, 8 cases
  50–60 years, 2 cases
  77 years, 1 case
Season
  January, 6 cases
  February, 5 cases
  March, 2 cases
  May, 2 cases
  August, 1 case
  September, 4 cases
  October, 5 cases
  November, 5 cases
  December, 1 case
Average duration before hospitalization, 5.92 days
Symptoms of onset (hospitalized cases)
  Cough: usually unproductive, all cases
  Fever (with chills 4 times; often sweats): all cases
  Headache: generalized, 22 of 24 cases
  Malaise: generalized, 22 of 24 cases
  Coryza: 9 of 24 cases
  Sore throat: 10 of 24 cases
  Signs of "encephalopathy" (dizziness 3 times; intense drowsiness 5 times; slight mental confusion 5 times): 24 cases
X-ray findings
  Multiple lobe involvement, 15 times
  Single lobe involvement, 9 times
Bacteriological findings in sputum
  Streptococcus viridans, all sputa
  Pneumococci: Type VII, 2 cases; Type VI, 1 case; unidentified, 3 cases
  Hemolytic streptococci, 3 cases
  Hemophilus influenzae, 2 cases
  Black mold, 1 case
Leukocyte count (average of 3 counts per patient)
  Average count, 10,600
  Highest count, 26,000
  Lowest count, 5,200
  Average count of *severe* cases (8), 16,270
  No departure from normal in differential counts
Urinary findings
  Trace of albumin only, 4 of 24 cases
  Albumin and casts, 4 of 24 cases
  Negative findings. 16 of 24 cases
Physical signs
  Râles over the affected areas, 23 of 24 cases
  Dullness (usually slight) over affected areas, 20 of 24 cases
  Bronchial breathing over affected areas, 9 of 24 cases
  Cyanosis, 12 of 24 cases
Results of sulfadiazine or sulfathiazole therapy
  No benefit except in one case in which pneumococci were found in sputum and one in which hemolytic streptococci were found in sputum.
  Average sulfadiazine level attained, 9.3 mg. per 100 c.c.
Total duration of fever
  Average, 16.2 days
  Shortest, 8 days
  Longest, 42 days
Complications
  Pleural effusion, 2 cases
  Otitis media, 2 cases (1 with *Streptococcus viridans* in ear culture; 1 with no growth in ear culture)

In the pneumococcus pneumonia cases studied over the same period, the average duration of fever after therapy began was 5.1 days and the average leukocyte count was 20,300. Response to therapy was usually prompt.

As can be observed from the above summary, the pattern of our cases followed that reported by other authors rather consistently. The onset was usually fairly sudden, with unproductive, irritative cough, dry inflammation of the throat and sometimes the nose, fever seldom ushered in by chill, headache, general malaise, and sometimes dizziness and intense drowsiness. The temperature range was usually in the neighborhood of 102° to 104° the first ten days, with a gradual fall by lysis, seldom reaching normal before the onset of the third week. The pulse, with very few exceptions, was low as compared to the fever. In our fatal case, it remained quite high throughout the course of the illness. This man had severe myocardial changes prior to his pneumonia. In the severe cases with much moisture, the pulse was usually high. The respiratory rate, except in the severe cases, was only slightly elevated in spite of cyanosis observed in more than half of our cases. The patients did not, as a rule, appear acutely ill at the onset, and usually did not

consider themselves so, as evidenced by the fact that the average time at which they sought medical attention and were hospitalized was 5.9 days after the initial symptoms.

Physical signs were scanty in the early stages. Sometimes a small area of dullness was noted prior to any change in breath sounds. In 4 of the hospitalized cases and 4 of those observed at home, dullness was not found at any time. Coarse and sometimes fine râles over the affected areas were the most constant physical finding. In 3 of the severe cases, they became extremely abundant, and these patients appeared to be partially asphyxiated from the large amounts of moisture in their bronchioles. Bronchial breathing was found in less than half of the cases, and when found was usually not intense. There were a few notable exceptions, however, in which the dullness over the affected areas was greatly increased, sometimes almost to flatness, and there was frank tubular breathing. In most instances, the leukocyte count was between 7,000 and 11,000; as noted above, the average of all counts was 10,600. There was a tendency for the total leukocyte count to rise slightly as the disease progressed. In the severe cases, the rise was usually sharper, the highest count recorded being 26,000. No change from a normal differential count was noted.

The urinary findings, as noted above, probably represent the average effect of any acute, prolonged infection on the kidneys. There was no instance in which we feel acute nephritis had been produced.

Usually, roentgen examination was required to be sure of consolidation in early stages, as the physical signs were rarely well developed in less than a week after the onset. In most instances, the shadows spread out from the hilus and were less dense than those seen with pneumococcus lobar pneumonia. The lower lobes were involved more frequently than the upper lobes, and the right a little more frequently than the left. In the majority of cases, more than one lobe was involved. The migration from one lobe to another and from one side of the chest to the other was often quite rapid. In Case 5, in which we feel that the patient had pneumococcus pneumonia superimposed upon "virus" pneumonia, the density in the right upper lobe was heavy and complete, while on the opposite side of the chest, soft, patchy, infiltrative lesions spread out fanwise from the hilus. In only two instances were dense shadows, having the appearance of typical pneumococcus lobar pneumonia, encountered in the absence of these organisms in the sputum.

As noted by other authors, sulfonamides apparently did not affect the course of the disease, except in two persons. In one of these, to be described later, we apparently were dealing with a "virus" infection upon which a Type VII pneumococcus infection was superimposed. Sulfadiazine, together with antipneumococcus serum, seemed to produce dramatic improvement in this patient. The temperature dropped sharply twenty-four hours after the serum had been given and sulfadiazine instituted in full doses and then went back for a few days almost to its former level. During this period of recrudescence of fever, however, the patient's respiratory rate was very little increased, and she did not appear acutely ill. She apparently at this time was experiencing the course of the usual "virus" pneumonia. The other instance in which sulfadiazine appeared to help, also described in detail below, was that of a man in whom hemolytic streptococci were found in the sputum. He was given convalescent scarlet fever serum along with the sulfadiazine. Sulfadiazine was used in practically every case, until it was concluded that it was having no effect. The average level of the drug attained in the blood was 9.3 milligrams per 100 c.c. Sulfathiazole was used in 3 cases. No beneficial effects were noted.

Pleurisy with effusion, occurring in 2 cases, was the only serious complication encountered. Guinea-pig inoculation in each instance was negative for tuberculosis. After the effusion, both patients made an

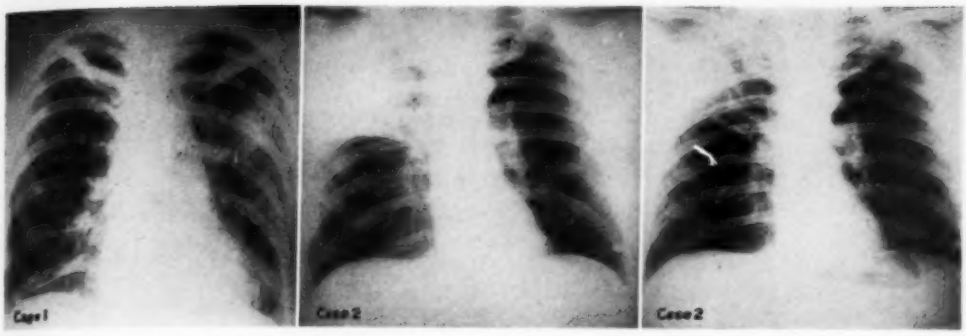

Fig. 1. Cases 1 and 2: Uncomplicated cases of moderate severity.

uneventful recovery, and there is no evidence of active tuberculous infection. It is interesting that both patients had a history of mild tuberculosis which had healed many years before. The otitis media noted in the summary was mild and lasted only a few days in each instance. *Streptococcus viridans* was cultured from the purulent secretion of the ear in one of the 2 cases. No organism was cultured from the ear of the other patient.

Most authors point out that, while the majority of the cases in their series conform to the pattern just described, a certain number are more severe, the fever being higher, the febrile course more prolonged, and the ensuing disability lasting many weeks. Kneeland and Smetana (22), in a series of 52 patients, had 23 whom they classified in this group. Longcope (10) has also pointed out that some cases may be quite severe. In our study, 8 of the 31 patients appeared to have a more severe illness than the others. Cases 3 to 7 belong in this group.

CASE REPORTS

The following case reports are given in detail because they are illustrative of some of the problems encountered. Case 1 is an example of an uncomplicated case of average severity. Case 2 also belongs in this category, but is presented because of the unusual roentgen findings and signs, which brought up the question of encephalitis at the onset. Cases 3 to 7 belong in the group of "severe" cases.

CASE 1: R. R., a 42-year-old housewife, became ill eleven days before admission, Feb. 8, 1942. She first noticed great fatigue and aching throughout her body, and some dryness "back of the nose." Next day, her temperature rose to 103°. The following day, her temperature remained in the range of 102° to 104°, and she felt "keenly alert and too sensitive to everything." Two days after the onset, a slight cough developed and grew in intensity. Eventually, it was productive of quantities of whitish sputum. A physician was then summoned, and prontosil tablets were prescribed. After three days on this treatment, during which "slight soreness through the chest" developed and headaches became a prominent feature, the patient dismissed her physician because the fever had been unaffected by the prontosil. On the tenth day of illness, she was sent to Wesley Memorial Hospital. At this time, her temperature was 102°; the cough was persistent and productive of slightly dark but not "prune-juice" sputum. The leukocyte count was 15,000, with 83 per cent neutrophiles. Four days later, it had dropped to 11,000. No pneumococci were observed on direct smears of the sputum, and on cultures only *M. catarrhalis* and *Streptococcus viridans* were found. Sulfadiazine in full doses was started on admission, but discontinued three days later because there appeared to be no clinical response. The temperature and pulse came down slowly and, by the seventh day after hospital admission (nineteenth day of illness), were normal. The highest respiratory rate recorded at any time was 32; the average was 24 during the febrile period.

CASE 2: J. D., a 38-year-old man, entered Wesley Memorial Hospital on Oct. 2, 1942, fourteen days after the onset of mild sore throat, headache, and cough. On the evening of the day on which these symptoms appeared, he felt well enough to go to a party. He went to bed at 2:00 A.M. and slept soundly until 6:00 P.M. next day. After awaking long enough to eat dinner, he went to sleep immediately and slept all night. He remained very drowsy but did not feel ill enough to call a physician until four days after the onset, at which time his temperature

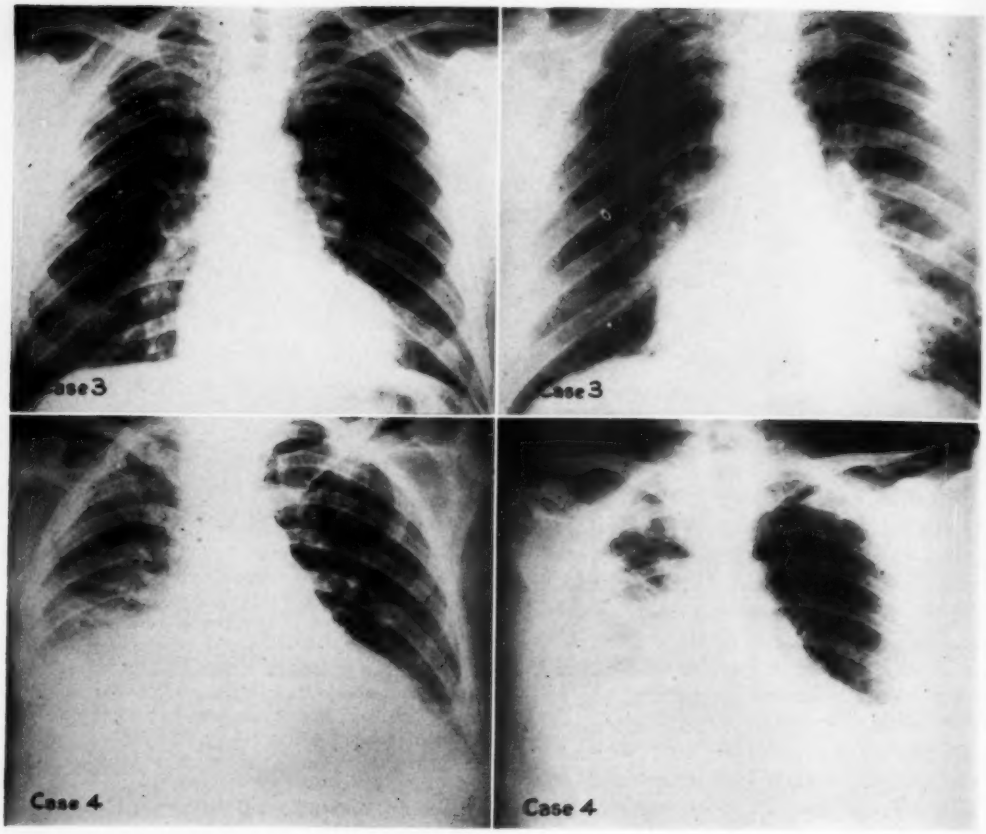

Fig. 2. Cases 3 and 4: Severe cases

was 104° and he had a severe headache, productive cough, and backache. The physician recognized that bronchopneumonia was present and prescribed sulfanilamide. The temperature remained at 102° to 104° for eight days before the patient entered the hospital.

On admission, the man did not appear extremely ill, and was never dyspneic nor cyanotic. The only physical signs of pneumonia were coarse and fine râles at both lung bases. There was thought to be slight dullness at the left base, but no dullness was found over the right upper lobe, even after x-ray films had revealed a very dense shadow there. No pneumococci or other unusual microorganisms were found in the sputum. The leukocyte count, which was 19,300 on admission to the hospital at the end of the second week of illness, dropped to 5,750 during convalescence. The rapid pulse observed throughout the first two weeks of hospitalization never returned.

CASE 3: T. L., a 36-year-old man, was seen in consultation on Nov. 14, 1941, six days after he entered Evanston Hospital, and ten days after the onset of his illness. His first symptoms were cough (productive from the start), fever, and general malaise. There was a history of a "blood stream infection with streptococci," complicated by pleurisy, in 1936. A physician was called the day after the present illness began, and therapy with sulfathiazole was started. Prior to hospital admission, several leukocyte counts, ranging from 8,000 to 10,000, had been done. Sputum cultures had revealed no pneumococci. A sputum culture, reported five days after admission to the hospital, contained hemolytic streptococci, and the leukocyte count had gradually risen to 14,900. Roentgenograms taken two days after admission revealed soft patches of consolidation in the lower portion of both lung fields. Sulfathiazole in doses of 0.5 gm. had been given at four-hour intervals during the first four days of the patient's hospitalization and then discontinued.

When first seen by the author, on the seventh hospital day (tenth day of illness), the patient was much more severely ill than the fever curve (temperature 102° F.) would indicate. The pulse was

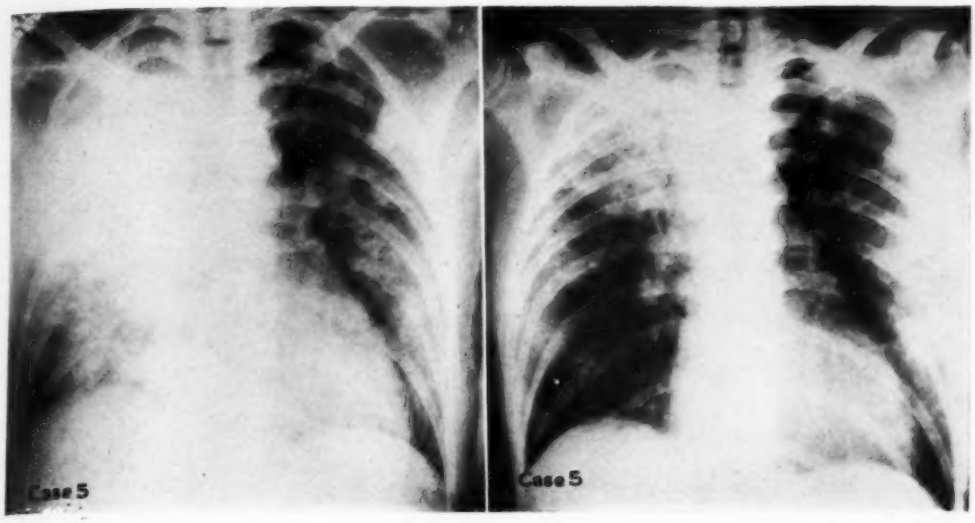

Fig. 3. Case 5: In this case there appears to have been a pneumococcus lobar pneumonia superimposed upon a "virus" type of infection.

120, the respiration 30–36, and there were marked restlessness, cyanosis, and dyspnea. The patient was mildly disoriented. Showers of fine râles together with coarse, bubbling râles were heard at both lung bases, and there was dullness over the lower portion of both lower lobes. The heart was enlarged slightly in both directions, rapid, with a gallop rhythm and frequent ectopic beats. Oxygen administration was started and decreased the toxic symptoms and cyanosis at once. Because of the finding of hemolytic streptococci in the sputum, sulfadiazine was given in doses of 1.0 gm. every four hours day and night. The blood level of sulfadiazine next day was 9.5 mg. per 100 c.c. Convalescent scarlet fever serum, 200 c.c., was administered by vein. Twenty-four hours after these measures were instituted, the patient was subjectively and objectively improved. His fever lasted only two more days. Sulfadiazine was discontinued three days after it was started because of the development of hematuria.

CASE 4: P. B., a 46-year-old housewife, experienced generalized muscular soreness and slight fever six days before entering Evanston Hospital. Three days later, she had slight sore throat and some pain in the right lower chest. On the day of admission, she did not feel or appear extremely ill but consented to hospitalization because of the persistence of the fever, development of an annoying cough, and definite pleural pain in the right chest. In spite of mild subjective symptoms and relatively low fever (101°), she was quite cyanotic. There were dullness over the right lower lobe and slightly distant tubular breathing with râles at the base. Only *Streptococcus viridans* was found in the sputum, and the leukocytes numbered 12,000. Next day, the count was 10,300 and there was no change in the differential count. Six days later, a few hemolytic streptococci were found in the throat culture. Sulfadiazine, which had been given in full doses since the onset, was continued, therefore, for two more weeks, but it apparently did not influence the course of the disease.

On the sixteenth day of hospitalization, a diagnostic thoracentesis revealed straw-colored fluid. A week later, 550 c.c. were removed. There was no growth on culture of the fluid. A guinea-pig inoculated with this fluid had no tuberculous lesions when autopsied eight weeks later.

It is interesting that this patient had an illness during adolescence strongly suggestive of tuberculous peritonitis and had a strongly positive tuberculin reaction prior to the present illness. Her course subsequent to the acute illness described above has been uneventful.

CASE 5: C. B., a 47-year-old woman, was seen in consultation with Dr. L. Hagen the day after she entered Evanston Hospital and eight days after she first became ill. At the onset, there was some pain in the right anterior chest, and fever. Later in the day, she had a chill and her temperature rose to 103°. There was some cough, with blood-tinged sputum. Another chill occurred the following morning. Two days later, the temperature was oscillating between 99° and 104°. In spite of this fever, she felt better next day and was sitting up in bed reading and visiting when her physician arrived. On the fourth day, her condition became worse. She was slightly delirious and the cough was more constant. When admitted to the hospital seven days after the onset, she was extremely ill; respiration was grunting,

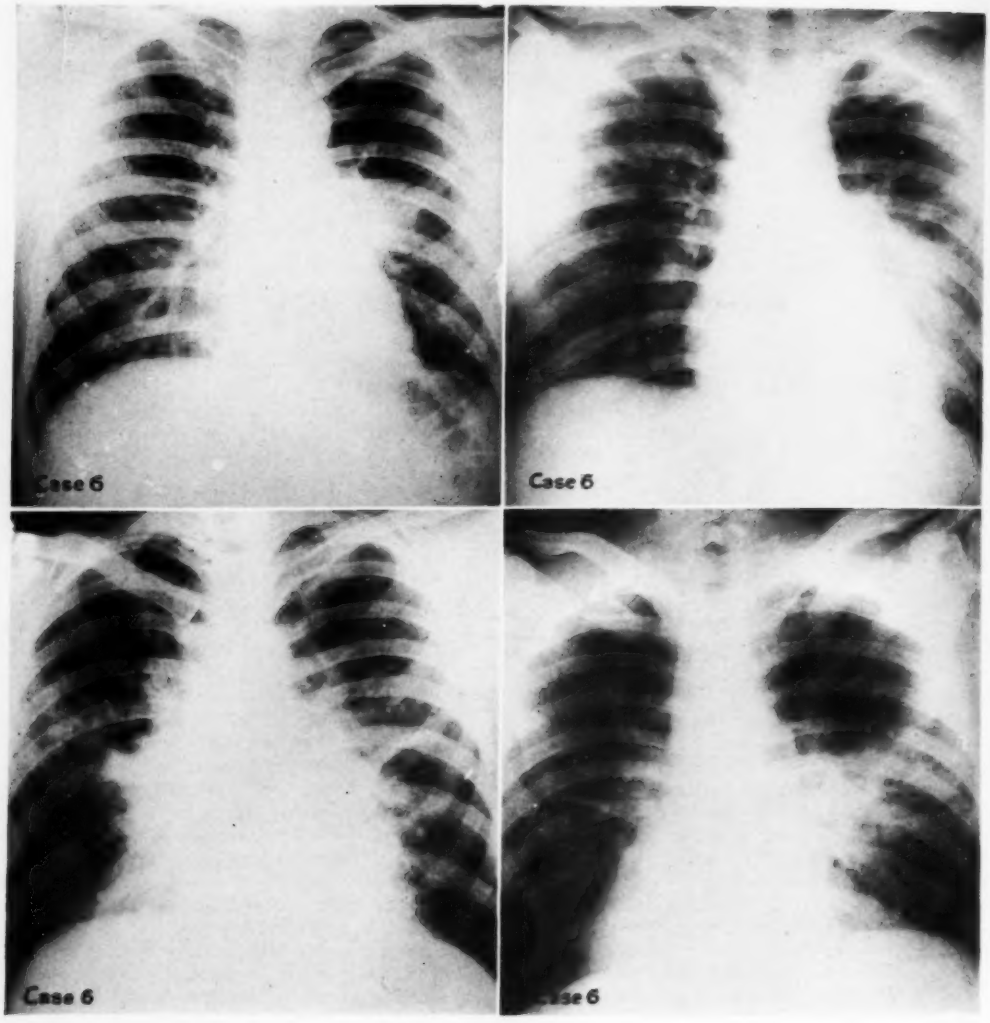

Fig. 4. Case 6: Severe case with prolonged course.

cyanosis marked. Abdominal distention was present in spite of oxygen therapy. The leukocytes numbered 10,900. Type VII pneumococci were found in the sputum. The blood culture taken the day of admission remained sterile. Sulfadiazine in full doses was started on the day of admission and, because of the delay in treatment, 200,000 units of specific antipneumococcus rabbit serum were administered on the second day of hospitalization. The following day there was a fall in temperature, but it quickly rose again, despite a steady drop in the pulse, respiratory rate, and leukocyte count. During this secondary rise in temperature, however, the toxic features continued to diminish, and subjectively the patient felt quite well. Because of this behavior of the temperature, pulse, respiration, and leukocyte count, together with the x-ray evidence of an extensive, soft, infiltrative lesion extending outward from the left hilus, in addition to the dense right upper lobe shadow, the presence of pneumococcus lobar pneumonia superimposed on a "virus" type of infection was presumed.

CASE 6: R. L., a 32-year-old man, entered Wesley Memorial Hospital on Sept. 6, 1942, the day following the development of mild sore throat, generalized aching throughout the body, a temperature of 102°, and a constant light cough. He had helped in the care of his sister, who had come down with

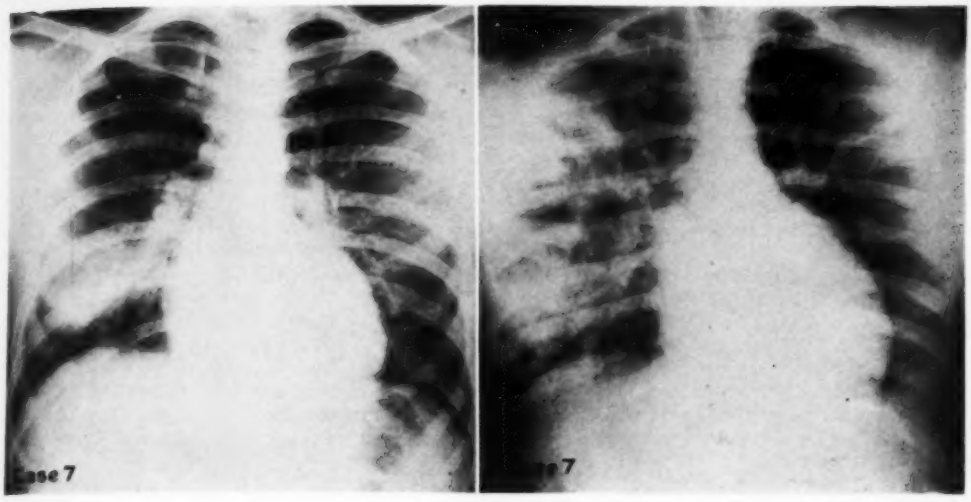

Fig. 5. Case 7: Severe case with fatal outcome.

primary atypical bronchopneumonia nineteen days previously. It was for this reason that he suspected his own illness might be of the same type and reported to his physician, Dr. W. Mackenzie, promptly. At the time of admission, his temperature was 103.6°, pulse 88, and respiration 24. He was already expectorating considerable slightly purulent sputum. The only thing of significance in the history was scarlet fever in childhood. On admission, the physical chest signs were negative, but slight cardiac enlargement and an apical systolic murmur were noted. Roentgenograms taken on the third day of hospitalization revealed an increase in density in the left hilar region, which was thought by the roentgenologist, Dr. Frank Hussey, to be compatible with "virus" pneumonia. The admittance leukocyte count was 13,550. No pneumococci were found in the sputum.

Six days after admission, at which time the patient was first seen by the author in consultation, there had been no response to full doses of sulfadiazine or to sulfathiazole, and he appeared extremely ill. At this time, roentgenograms revealed an increase in the size of the consolidated area and, over the left lower lobe, marked dullness, tubular breathing, and showers of fine râles were elicited. Coarse râles were heard on the opposite side of the chest. There were short periods of delirium; the cough was constant and "rattling," but very little sputum was brought up. When oxygen was stopped, even momentarily, the patient became extremely cyanotic. This course continued for two more weeks, the temperature range being 104° to 99.4°. During this time, the pulse rose gradually until it was remaining constantly between 100 and 120. The respiratory rate increased steadily and for almost three weeks was seldom below 40 a minute. The patient seemed constantly to be fighting for air and became extremely dyspneic on the slightest exertion. Extreme apprehension and periods of disorientation continued. Both physical and roentgenologic examination revealed a rapid spread of the lesion, beginning on the left side and then involving the midportion of the right lung. This became very extensive. The patient appeared to be almost asphyxiated from the large amounts of fluid within the bronchi, and bronchoscopic aspiration was seriously considered. After the administration of potassium iodide, however, he began to expectorate large amounts of tenacious mucopurulent sputum, so that aspiration was not done. Several blood cultures were negative for bacterial growth. On Sept. 15, nine days after admission, culture of the sputum revealed a moderate growth of *Streptococcus viridans*, *Micrococcus catarrhalis*, and *Hemophilus influenzae*. Later, black mold and Endodermophyton were found on sputum culture. Spirochetes, fusiform bacilli, and tubercle bacilli were looked for in several sputum specimens, but none was found.

On Sept. 18, the patient was given 500 c.c. of blood, the donor being his sister, from whom he apparently had contracted his infection. Sulfathiazole was continued several more days, but was discarded because it appeared to have no effect. After a prolonged and stormy course, during which the patient's life was several times despaired of, the temperature and pulse returned to normal, and he was discharged in the sixth week of his illness.

CASE 7: M. B., a 22-year-old man, was seen in consultation with Dr. G. Barry three days after admission to the Evanston Hospital and nine days after the onset of his illness. His physician stated that the young man had been turned down by the Navy "because of his heart"; four years previously

he had been found to have cardiac enlargement and a greatly diminished capacity for physical work. An electrocardiogram made two years before the present illness revealed a negative T-wave in all leads except 3, and right ventricular preponderance. The reason for this unusual electrocardiogram was not apparent at that time. There had been no history of rheumatic fever, scarlet fever, etc.

The present illness began with cough, headache, general malaise, and fever. The patient had not felt particularly ill at the start, and his physician was not summoned for two days. During the interval prior to hospital admission, all of the symptoms increased slowly in severity, so that hospitalization was felt to be best six days after the illness began.

At the time of admission, the temperature was 101.6°, pulse 118, and respiration 22. The patient did not appear to feel particularly ill. The leukocytes numbered 8,250, and the differential count was normal. Roentgenograms revealed a partial consolidation of the right lower lobe. When first seen by the author, three days later, the patient still did not appear acutely ill, although he was slightly cyanotic, even when oxygen was being administered, and was dyspneic on slight exertion. No definite area of dullness was found; there was no bronchial breathing. Coarse and fine râles were heard extensively over both lung fields posteriorly. X-ray films revealed at this time extension of the shadows, so that almost the entire right lung was involved and a portion of the upper left lung. No pneumococci were found in the sputum, and cultures, when seen the next day, revealed only a heavy growth of *Streptococcus viridans*. Albumin and many granular casts were present in the urine. Sulfathiazole had been given until the third day after admission. Then, sulfadiazine in full doses by mouth was started. Because of the patient's serious condition, the drug was given intravenously at twelve-hour intervals from this time on until his death. The leukocytes gradually rose until a count of 26,750 was reached the day before death. A blood transfusion (not from a convalescent patient) was given on the day of death.

The significant autopsy findings, as reported by Dr. Raleigh, pathologist at the Evanston Hospital, are given below. It was felt that the severe myocarditis probably was responsible for the patient's inability to combat the infection. The clinical course in the first 10 days of illness, and the absence of bacteria which could be directly related etiologically in the sputum, led us to believe this was "virus" pneumonia. However, at autopsy, material aspirated through the chest wall from the lungs before the thoracic cavity was opened gave a heavy growth of *Streptococcus viridans*. Mice inoculated intranasally with unfiltered sputum and also ground-up lung tissue from this patient developed extensive bronchopneumonia on the first trial, and it has been possible to transmit this disease easily from one mouse to another by intranasal inoculation with the unfiltered material. So far, we have not been able to produce changes in the mouse lung with the filtrate.

Autopsy Report: "*Heart:* The muscle fibers are markedly hyperplastic. In scattered areas they exhibit all gradations of retrogressive change: swelling of the nucleus with disappearance of the paranuclear clear area, karyorrhexis, loss of cross-striations, parenchymatous degeneration, to frank necrosis with fragmentation. There is a tremendous increase of fibrous tissue between muscle bundles and, occasionally, between individual fibers of the syncytium. This varies from mature collagenous to active, fairly vascular, fibroblastic tissue. Occasional proliferations of Anitschow myocytes and fibrocytoid cells, which tend to be associated with vascular radicles, lack the architecture of Aschoff bodies. The endocardium, epicardium, and blood vessels are normal.

"*Lungs:* The central portions of an involved area reveal compressed, ischemic alveolar walls. The alveoli are filled with fibrin, numerous large mononuclear macrophages, some of which contain brown pigment granules, a few erythrocytes, and rarely a neutrophile. Edema fluid, inconspicuous at the center, becomes more conspicuous as the periphery is approached, finally becoming the only content of the alveoli. There is desquamation of the bronchiolar epithelium and the lumens are filled with these cells, fibrin, mononuclear macrophages, and very large numbers of neutrophiles. The pleura is normal."

ROLE OF SECONDARY BACTERIAL INVADERS

Kneeland and Smetana (22) have commented upon the fact that complications in the form of atypical primary bronchopneumonia being discussed are rare, and point out that this disease has fewer bacterial complications than did the cases in the influenza epidemic of 1918–19. Goodrich and Bradford (23) go so far as to state that in their opinion this type of pneumonia produces in the host an increased resistance to bacterial invasion. While bacterial complications up to this time have not been prominent, it is questionable whether patients with the type of pneumonia under discussion have an increased resistance to them. Our experience leads us to believe that bacterial complications are becoming more frequent. The average leukocyte count in the group of cases which we classed as severe was 16,100, as opposed to an average of 10,600 for the entire series. In Cases 4, 5, 6, and 7, the almost certain role of secondary

bacterial invaders has been described. The role of *Streptococcus viridans* in producing secondary lesions is extremely difficult to evaluate, because it is so constantly present in the sputum. However, at least in our fatal case (Case 7), the evidence points strongly to the fact that it played an important part in contributing to the patient's death. Careful analysis of the case histories in the series of Kneeland and Smetana (22) reveals that the majority of their "severe" cases also had a definite leukocytosis, and in many, secondary invaders were encountered in sputum examinations but were not thought to be of great importance. Pneumococcus, type X, was cultured from the lungs in their fatal case.

TREATMENT

It is our opinion that a study of the bacterial flora of the sputum, nose, and throat of patients with primary atypical bronchopneumonia is of the utmost importance in prognosis and in planning treatment. Unless these organisms are constantly looked for, specific serum which may be useful against them, and sulfonamide therapy, may be withheld simply because enough cultures have not been taken. In the present state of our knowledge, most practitioners will probably be tempted to use sulfadiazine or sulfathiazole, at least at the start, in the majority of these cases. This procedure is probably justified for its possible effect in preventing infection with secondary invaders. If, however, careful bacteriological examination reveals no other organisms than *Streptococcus viridans* in the sputum, marked leukocytosis does not develop, and there seems to be no response in the fever curve or the patient's subjective features to the drug, it is not worth while to continue it. A blood transfusion, the donor being a patient recently recovered from primary atypical bronchopneumonia, was used in therapy only once in our series. Because other measures were used in addition, its effect could not be accurately estimated. However, this should be a worth-while procedure, and we shall use convalescent whole blood or serum again if the opportunity arises.

Oxygen was used on all of our patients who had "wet" lungs or marked cyanosis from any cause. Means has pointed out that bronchopneumonia associated with large amounts of exudate in the smaller bronchi usually interferes with the respiratory exchange more than a relatively dry consolidation of an entire lobe, if the free passage of air to the other parts of the lungs is not interfered with by extensive bronchial secretion.

CONCLUSION

A peculiar type of primary bronchopneumonia, rarely encountered until two years ago, is now widespread in this country. In a few instances, a virus capable of producing characteristic changes in ferrets, mongooses, or mice has been found in the sputum of patients having the disease. Since identification of the virus is impossible for most clinicians, the diagnosis for them must be based upon the clinical evidence, which includes: absence in the sputum of characteristic bacterial agents in sufficient numbers to be etiologically significant; the absence of advanced physical signs of consolidation at the start; x-ray signs of lung infiltrates which are less dense than the consolidation usually observed in pneumococcus pneumonia, but out of proportion to the scanty physical signs; lack of response to any of the sulfonamide drugs; relatively low respiratory rate; absence of prostration as compared to the amount of consolidation shown on the x-ray film; a normal or low leukocyte count in uncomplicated cases. Most cases are self-limited.

Our own experience leads us to disagree with those authors who state that secondary bacterial invaders are unimportant in this disease. We feel that they have much to do with the severity of the attacks and will probably play an increas-

ingly important role as the epidemic progresses.

In primary atypical bronchopneumonia, every effort should be made to discover the entire bacterial flora of the sputum. The most useful treatment is that directed at combatting secondary invaders and improving oxygenation in those patients with large amounts of moisture in the bronchi.

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Pathological Changes in So-Called Atypical Pneumonia[1]

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THE LESION WHICH forms the topic of this discussion has a most varied nomenclature. Such terms as pneumonitis, atypical pneumonia, atypical bronchopneumonia, bronchopneumonia of unknown etiology, acute interstitial pneumonia, and virus pneumonia with various modifying symbols, are used interchangeably.

This pneumonia is in some respects quite different from bronchopneumonia and lobar pneumonia. The clinicians and roentgenologists were probably the first to direct attention to it. The former pointed out the relatively benign nature of the disease and the impossibility of obtaining any specific pneumococci, or a definite growth of streptococci or of other organisms, which could be considered to be the etiologic factor. The roentgenologists were impressed with the rapid appearance of lesions in various lung fields and their fast disappearance. They were the first to describe the interstitial features of the disease, and it was they who coined the term, "acute pneumonitis," using the x-ray expression pneumonitis, which embraces all interstitial lesions, either inflammatory or occurring as the result of chronic passive hyperemia.

It soon became obvious that this acute pneumonitis resembles clinically, and even more so anatomically, the pneumonia seen in psittacosis, rickettsial diseases, and particularly in so-called Q fever. This last is a definite, infectious type of pneumonia which has occurred in epidemic form in Queensland, Australia. While it was first thought to be caused by a virus (virus Q), it is realized today that the causative organism is a rickettsial body (*Rickettsia burneti*) in some way related to a virus. Because of the similarity of the clinical symptoms, the course of the disease, and the pathologic findings, it appeared evident that the so-called atypical pneumonias which have lately been observed may also be of virus origin.

Pneumonias anatomically are classified as lobar, broncho-, and interstitial. Lobar pneumonia and bronchopneumonia are easily differentiated. The total or almost total involvement of one lobe in lobar pneumonia, the uniformity of color, and the dryness are characteristic grossly. The pleura is often covered with fibrin. The uniform type of exudate throughout the lung fields and the presence of fibrin are distinguishing features. Lobar pneumonia is caused most commonly by *Diplococcus pneumoniae*. Bronchopneumonia is lobular in character. Patchy areas of consolidation are present. These are poorly defined; they are moist, though drier than the surrounding lung tissue, and vary in color. Acute interstitial pneumonia may extend from the pleura or the mediastinal lymph nodes to the peribronchial and perivascular lymphatics into the interalveolar tissues, with secondary involvement of the alveoli. The acute inflammation may also extend from the bronchi into the adjacent alveoli by way of the peribronchial lymphatics rather than down the lumens of the bronchi into the bronchioli and hence into the alveoli. Interstitial pneumonia was well known to the older pathologists. It was often specially noted as a complication of whooping cough and measles.

Mention should also be made of so-called influenzal pneumonia, particularly of the type observed in 1918–19. As Boyd (2) has pointed out, "with all the work that has been done in recent times

[1] From the Department of Pathology, Michael Reese Hospital, Chicago, Ill. (The department is in part supported by the Michael Reese Research Foundation.) Presented, as part of a Symposium on Atypical Pneumonia, before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 5, 1942.

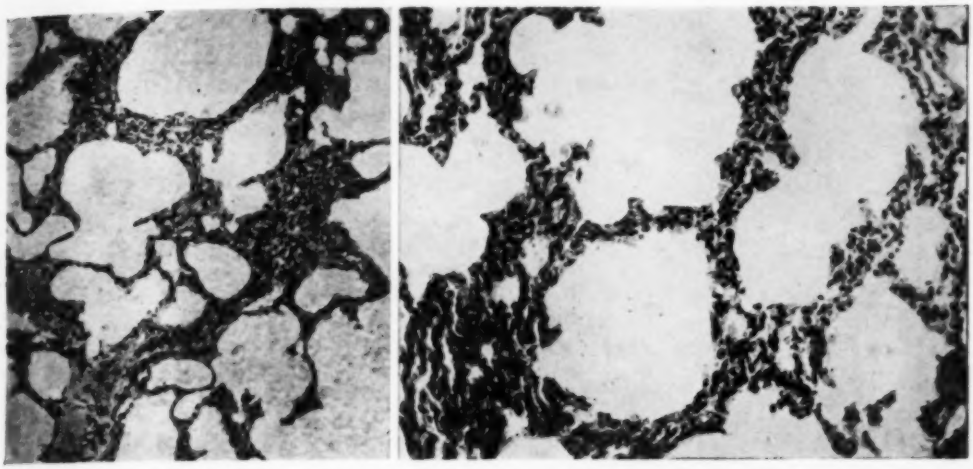
—and it is hardly too much to say that every pathologist and bacteriologist in the world attacked the problem during the late pandemic—it is a remarkable fact that some of the major questions regarding the disease still remain unanswered." Though *Haemophilus influenzae* was often found, it is commonly thought that a filtrable virus was responsible for this infection. Boyd pointed out that, in the lung, the characteristic lesion in early cases was a focal interstitial bronchopneumonia. The distribution of the lesions did not follow the distribution of an involved bronchus or bronchiole, as in bronchopneumonia, but was nevertheless lobular because the lobules adjacent to the bronchioles were involved. Histologically polymorphonuclear leukocytes, lymphocytes, and some fibrin were encountered. Apparently characteristic was the formation of a hyalin-like membrane lining the inner walls of many of the alveoli.

It is thus interesting to note that interstitial pneumonia has long been known to occur in association with infectious diseases caused by viruses, such as measles, and also that the epidemic influenza of 1918–19, which now is considered to have been caused by a virus, was in its initial stage an interstitial pneumonia.

Because of these facts, and in view of its similarity to some of the other virus or rickettsial diseases known today, the possibility that so-called atypical pneumonia may also be produced by a virus becomes more and more likely. As a matter of fact, there are already on record a number of instances of atypical pneumonia in which virus studies were made and a virus was proved to be the cause of the disease.

Virus studies are most difficult. Not only must isolation of the virus be attempted, but proof must be furnished that it and not associated bacteria, which may be present and biologically bound to the virus (symbiotic or parasitic), has caused the disease; further that the experimentally produced disease is actually caused by a virus isolated from the human lesion and not by a virus indigenous to the laboratory animal. We know, for instance, that in swine the swine influenza bacillus is always present, together with a special virus. On the other hand, the neurovirus of Levaditi, is capable *per se* of producing pneumonia if inoculated intratracheally. Also the virus of the Shope papilloma alone is capable of producing the disease. The presence of organisms in the sputum and in the lungs does not rule out a simultaneously present virus which may have been the sole cause of the disease. Thus, in retrospect, the presence of Pfeiffer's organism or streptococci such as were found in the lungs during the influenza epidemic of 1918–19, does not disprove the possibility that the influenza may have been caused by a virus. Though our knowledge of viruses is still incomplete, one fact stands out clearly, though not pertinent to all virus diseases: the highly contagious nature of virus disease. Many laboratory workers handling viruses contract disease. This is one reason why virus studies are not more frequently done as a routine in the various laboratories.

If the human material which supposedly contains the virus is suitably prepared and introduced intranasally or intratracheally into the experimental animal, and if the animal succumbs and shows a pneumonia, the question must still be answered whether the pneumonia resulted from the inoculated virus or was the result of a virus which the experimental animal happened to harbor. Thus, it is essential to immunize a second experimental animal with the virus cultivated from the lung of the first animal. If the serum of the immunized animal neutralizes the virus obtained from the human lung—*i.e.*, if this mixture fails to produce pneumonia in a suitable animal —the chances are that it was the virus from the human lung which produced the original pneumonia. A simpler method of evaluating a virus is applicable if serum of the patient is available in the beginning of the disease and at later stages. Under these circumstances antibodies against the virus, which are at first absent, may



Figs. 1 and 2. Interstitial pneumonia (Case I). In Fig. 1 (left) note the involvement of the alveolar walls. Iron-hematoxylin-eosin preparation. ×95. Fig. 2 (right) shows the predominance of monocytic cells in the alveolar septa. Iron-hematoxylin-eosin preparation. ×130.

subsequently be demonstrated and used in neutralizing experiments.

I mention these difficulties simply to explain why so little is known about the virus of so-called atypical pneumonia. For convenience, some investigators call the virus of pneumonia of certain epidemics, virus X, influenza A virus, influenza B virus, etc.

As stated before, the common varieties of virus pneumonia, as observed at present, are not particularly severe, and for this reason necropsy material is not abundant. There are, however, some reports of postmortem findings in the literature, and I have seen a few cases which came to necropsy. Perhaps the most significant histologic feature observed in virus pneumonia is the presence of inclusion bodies. These intracytoplasmatic inclusions, described by Adams (1), are found in the epithelial cells of the bronchial tree and apparently in the lining cells of the alveoli. They are spherical eosinophilic bodies often surrounded by a halo. While Adams found them within the cytoplasm of epithelial cells, others have found them to be intranuclear. In some instances it is difficult to demonstrate inclusion bodies, though, according to other observers, they seem to be found with relative ease.

Two instances of possible virus pneumonia were observed by me recently. No virus studies were made, however, and the virus etiology is therefore questionable.

CASE I: A three-year-old girl was admitted to the hospital because of vague pains in the abdomen. A tentative diagnosis of acute appendicitis was made, but the child started to cough, became cyanotic, and died shortly thereafter. At autopsy the lungs were larger than normal and red. The hilus nodes were enlarged, and from them gray and white streaks extended into the adjacent pleura and lung tissue. On section the surfaces were red, mottled with gray. No definite area of bronchopneumonia could be recognized grossly, but foci of atelectasis were obvious. The surfaces showed thickened septa surrounded by slightly granular regions which seemed relatively dry. Similar areas were observed surrounding the smaller bronchi and blood vessels.

Histologically the interstitial nature of the lesions was clear. Throughout the septa many lymphocytes and only very few polymorphonuclear leukocytes were found. A few alveoli contained lymphocytes and desquamated cells. Red blood corpuscles were also present within the lumens of some alveoli. There were very few bacteria in the lung, none predominating.

This lesion was classified as an interstitial pneumonia, and only recently the sections were restudied. The lining cells of the bronchi showed very few eosinophilic inclusion bodies, which, however, were not quite similar to those described by others (Adams) because, though spherical, they were not surrounded by a halo. Nevertheless,, they were definitely not bacteria.

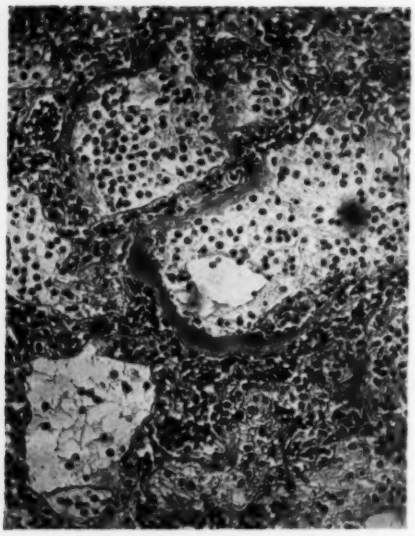


Fig. 3. Case II. Note the involvement of the septa, the presence of monocytes and a few polymorphonuclear leukocytes within the alveoli, and the hyalin-like ring lining the inner wall of one alveolus. Giemsa preparation. ×130.

The second case was much more dramatic.

CASE II: A twenty-nine-year-old woman, in the eighth month of pregnancy, had a slight sore throat, so insignificant that she received only simple "medicine chest" care. During the night her condition improved, but the next day the pain reappeared and she began to have an irritating cough. Since a slight cyanosis and parasternal pain developed, she was brought into the hospital, where she spent a comfortable night. The next morning (third day of the illness) the cough became more severe and the cyanosis increased to such a degree that the patient had to be placed in an oxygen tent, which, however, gave her no relief. Her temperature varied between 100 and 102°. The white cell count was 23,000 with 80 per cent polymorphonuclear leukocytes. The sputum failed to show pneumococci or any predominating organism.

In spite of heroic measures, the patient died the same evening, with severe cyanosis. At necropsy the lungs were found to be larger and heavier than normal. The right pleura revealed a small amount of fibrin. Section showed numerous elevated, reddish or reddish gray, finely granular or velvety regions which were wet, though drier than the surrounding lung tissue. Definitely older lesions were found in the right lower lobe. The bronchi were often filled with a hemorrhagic, edema-like material. In the left lung non-aerated, bluish-red areas were present with streaks of yellowish white to yellowish red traversing the seemingly atelectatic foci. These streaks were also observed through the intact pleura. The hilus nodes were enlarged and soft.

Microscopically the changes varied, corresponding to the age of the lesion. In the left upper lobe the changes were characteristic of interstitial pneumonia. The capillaries were hyperemic, and the interstitial tissue was crowded with lymphocytes, and monocytes, with only very few polymorphonuclear leukocytes. The alveoli were empty or contained monocytes, an occasional polymorphonuclear leukocyte, and red blood corpuscles. Often an eosinophilic, thin, hyalin-like membrane was closely attached to the inner lining of the alveoli. In other lobes transition from these early changes to those of typical lobular pneumonia were noted. While some of the

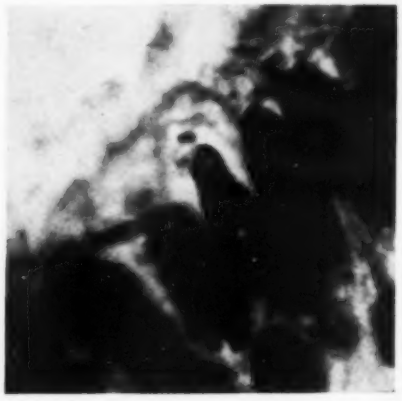


Fig. 4. Bronchial mucosa lining cells (Case I), showing an intracytoplasmatic inclusion body. Hematoxylin-eosin preparation. ×1755.

cells within alveoli were polymorphonuclear leukocytes, the majority were monocytes. A few red blood corpuscles were also seen. Very few microorganisms were present in the sections of the lung.

The histologic changes in this second case are quite characteristic. It is evident that the initial changes were entirely of an interstitial nature. These changes, together with the enlargement of lymph nodes, gave rise to the dyspnea and cyanosis which were such prominent clinical signs. It seems that these anatomical changes in the early stage are easily reversible and such patients get well in a relatively short time. In some instances, however, the interstitial changes spread and the alveoli become involved. The first indication of their involvement seems

been referred to as central. We have found that in cases of this type a lateral projection will frequently show the lesions along the bronchus dorsalis, which supplies the apex of the lower lobe, either right or left, and again a patchy increase of peribronchial density is present (Fig. 4). It must be stated, however, that when the bronchus dorsalis is involved, the patches most frequently become confluent, and a slight pleural thickening occurs, so that the shadow appears more or less homogeneous. Again, however, if films are taken during resolution, the patchy character of these lesions becomes evident.

Because of the character of this disease, the diagnosis has at times been suggested by a routine survey film of the chest. In these cases patches of increased peribronchial density along a lower, and in one case an upper, lobe bronchus were observed. Since it is our policy to request clinical examination of the patient and stereoscopic films before reaching a final decision, we have been able in these instances to make correct diagnosis of primary atypical pneumonia from the history of recent moderate upper respiratory infection and subsequent x-ray observation showing resolution. We would like to warn those who interpret survey films to keep this disease entity in mind, as its occurrence is by no means rare, and a little care will save many an able man for military duty. This point deserves strong emphasis.

Following the diagnosis, the patient can be expected to be incapacitated for a period of two or three weeks. If he is allowed out of bed too early, recurrence is not unlikely. We have, however, as yet found no sequelae or complications in our series of cases, although the period of illness varies considerably depending upon the severity of the disease.

Treatment is symptomatic.

Station Hospital
Camp Davis, N. C.

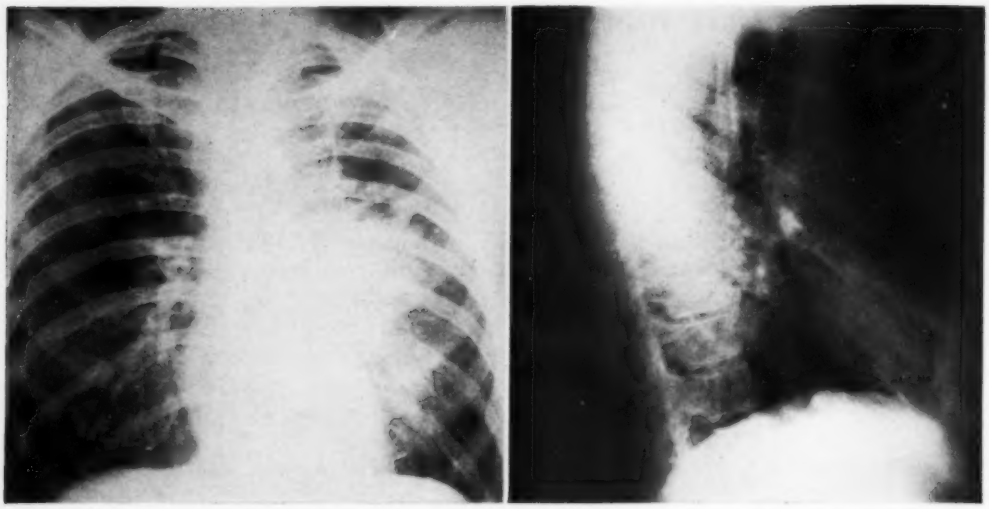


Fig. 4. Frontal and lateral views of case of atypical pneumonia involving the apex of the left lower lobe. The lateral view shows the patchy type of infiltration along the bronchus dorsalis.

The patient presents himself with rather vague symptoms. He has felt badly for several days and believes that he has a temperature above normal. This may be the only history obtainable, or he may have a cough and a moderately severe frontal headache. He may complain, also, of various body aches and pains.

Examination is quite unsatisfactory. A temperature of 103 or 104° F. is usually present and the patient appears not acutely or dangerously ill, but definitely uncomfortable. Physical examination of the chest most frequently gives entirely negative results, and the patient is hospitalized with a working diagnosis of upper respiratory infection, even though upper respiratory symptoms are mild and vague. The usual routine laboratory examinations on blood and urine are all reported normal or negative. For a period of forty-eight hours the patient is watched carefully and treated symptomatically. The temperature does not drop and an x-ray examination of the chest is ordered.

The information gained from the x-ray examination is the deciding factor in arriving at the diagnosis. Most frequently there is a thickening of one or both hilar shadows, and a patchy type of peribronchial increased density is seen along the basilar branches of one of the inferior lobe bronchi. These patches, despite their peribronchial distribution, may show a tendency toward confluence (Fig. 2). Commonly, the infiltration may be confluent to such an extent that the involvement appears lobar, and the density may not appear patchy in the least. There may be an associated thickening of the visceral pleura over the involved lobe, producing a shadow of more or less homogeneous density very much resembling lobar pneumonia (Fig 3). In this type of case, however, the clinical condition and a normal white blood cell count rule out lobar pneumonia and determine the correct diagnosis of atypical pneumonia. X-ray examination of the chest, made during resolution, again shows a peribronchial type of patchy infiltration. It is extremely interesting to note that the involvement is always along the distribution of a portion of the bronchial tree. It may be limited to one branch, as the dorsal basilar branch of the inferior bronchus, or all the branches of a major bronchus may be involved. Several lobes have shown the involvement at the same time in some cases.

Of special interest is the type which has

Fig. 2. Confluent peribronchial infiltrations in atypical pneumonia.

Fig. 3. Atypical pneumonia resembling lobar pneumonia.

ings are entirely absent until the diagnosis has already been established. In no case have physical findings of a positive nature led to a diagnosis of another type of pneumonia.

4. Probably the most striking observation has been the behavior of the white blood cell count. During the height of the temperature reaction and at the time of the early x-ray findings, the count is not above normal (8,000 to 10,000). Later in the disease, during resolution and at the height of physical findings (coarse râles), the count may rise to 14,000 or 15,000. No leukopenia has been observed.

5. This disease, we feel, does not respond to chemotherapy. In several of our early cases, a pseudo-response was noted, but we now believe that, because of the mild nature of the subjective symptoms, these cases had run their course before entering the hospital, and the improvement in twenty-four to thirty-six hours following administration of the drug was not due to its specific action.

6. The laboratory findings have not been helpful except in a negative way. Usually the sputum contains gram-positive cocci in chains and a few gram-positive diplococci having the morphology of pneumococci, but showing no quellung (Neufeld) reaction. We have not felt that these bacteria are in any way associated with this disease entity. To date we have not been able to culture or to investigate further these morphologic pneumococci showing no quellung reaction.

7. A less evident finding has been a relatively slow pulse. The temperature may reach 104° F. while the pulse has been 90 or 100 per minute.

Primary atypical pneumonia of unknown etiology is not entirely a new disease entity. It was described in 1935 by Colonel Albert Bowen. Our attention has been called to it recently, we believe, because of early and frequent x-ray examination of the chest in all moderately severe cases of upper respiratory infection occurring in the armed forces. Many cases have probably gone unrecognized in the past because of the unavailability of x-ray studies to the physician seeing patients in the home. The fact that these patients failed to recover in the usual two to three days, although there was an absence of physical findings in the chest, could not be adequately explained.

In our experience the story of atypical pneumonia is as follows:

Primary Atypical Pneumonia of Unknown Etiology[1]

MAJOR F. C. CURTZWILER, M. C., and MAJOR B. E. MOORE, M. C.
Station Hospital, Camp Davis, North Carolina

DURING THE PAST year and a half we have encountered at Camp Davis, N. C., a disease of the respiratory tract of a somewhat unusual character. This disease has also been observed in several other sections of the United States, both in civil and military practice. Our introduction to it at Camp Davis occurred when on two occasions we interpreted roentgen changes of minimal extent in one of the upper lobes near the periphery, in the frontal plane projection, as tuberculosis, only to find on subsequent examination, a few days later, that the lesion had disappeared (Fig. 1).

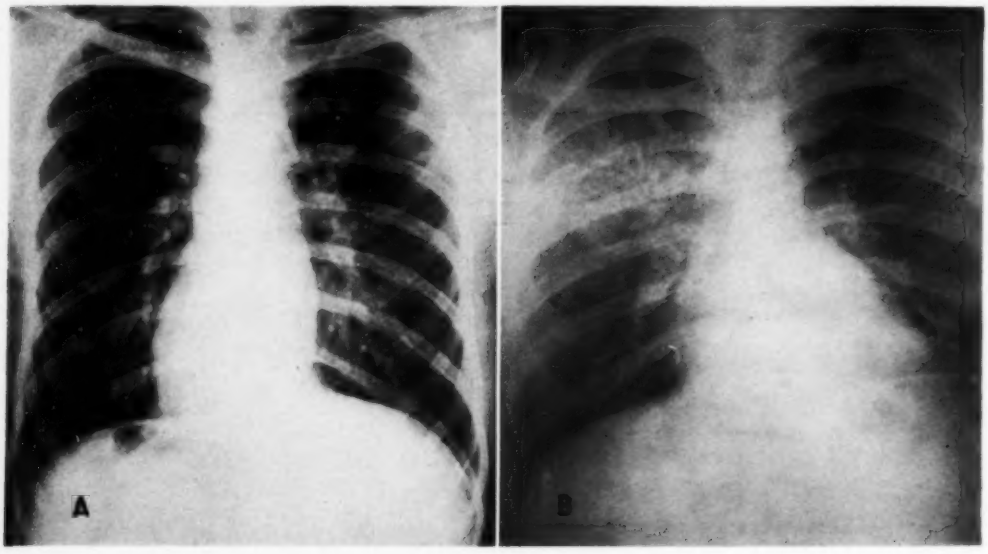


Fig. 1. Atypical pneumonia resembling (A) minimal and (B) more extensive pulmonary tuberculosis.

Needless to say, our error drew more than the usual criticism from the staff, and hence whetted our ambition to explain this seeming gross irregularity. We have accordingly come to recognize both the clinical and x-ray findings in these cases as primary atypical pneumonia of unknown etiology. The following are the conclusions we have drawn from a review of slightly over 100 cases.

1. The diagnosis depends upon the clinical picture, with associated x-ray findings. We are convinced that in no case could a diagnosis be made on either the clinical course or the x-ray findings alone.

2. The chief complaints, in order of occurrence and frequency, are: general malaise, weakness, cough (not productive), fever, and general body aches.

3. Absence of physical findings is especially notable early in the disease. Later, after the diagnosis is established, coarse râles can be heard over the entire chest, not entirely limited to the area of parenchymal involvement, although most marked there. Commonly, physical find-

[1] Presented, as part of a Symposium on Atypical Pneumonia, before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill.

In lesions of the bases, of whatever type, the diaphragm remains uninvolved, though early there may be an elevation of the affected side, a splinting effect. Pleural adhesive processes rarely develop and the finding of pleural fluid is a rarity.

ILLUSTRATIVE CASE HISTORIES

CASE I (Group I): J. B. S., white male, entered the hospital complaining of headache, backache, sore throat, and a slight cough. His illness had begun the previous day with chills and fever. The temperature on admission was 101.2° F. and remained elevated for four days. The patient was only moderately ill. On the eighth day a non-suppurative otitis media developed. The white cell count was 8,150 on the first hospital day; 8,850 on the fourth day.

The initial chest film (Fig. 1A) showed increased hilar shadows, particularly on the right, with prominent lung markings extending into the right base. Subsequent films showed extension of the lesion, until it completely involved the right lower lobe, and eventual resolution.

CASE II (Group II): C. C. W., white male, age 22, entered the hospital complaining of sore throat and headache. He had been taken ill the preceding day, with general weakness, headache, sore throat, and a temperature of 103° F. The temperature on admission was 102° and did not exceed this during the patient's stay in the hospital, though it continued above normal for six days. The white cell count was 6,950 on the second day and 8,400 on the fifth day. The patient was not severely ill. The initial film (Fig. 1B) showed patchy density in the right upper right lobe, having the appearance of a bronchial pneumonia. Subsequent films showed rapid regression and eventually complete resolution of this process.

CASE III (Group III): H. W. N., white male, age 30, was admitted to the hospital, immediately following sick-call, with headache, pain in the chest, cough, and chills. His temperature was 100.6° on admission but subsided after the second day. He was only moderately ill, but weakness and cough persisted for some time after return of temperature to normal. The white cell count was 8,400 on the first day, 8,500 on the third day, 5,150 on the sixth day.

The roentgenogram (Fig. 1C) showed prominent lung markings extending into the right upper lobe, beginning in the hilus region, and associated soft infiltrations. Three days later the entire upper right lobe showed diffuse infiltration. Five days after this only a minimal residue was demonstrable.

CASE IV (Group IV): J. L. F., white male, age 25, was ill for three days before entering the hospital. He complained of chest pain aggravated by cough and deep breathing. The early course was stormy, with fever for eight days, a hard productive cough, pain in the chest, rapid respiration, and cyanosis, requiring oxygen therapy. The white cell count was 12,000 on the day of admission, 9,200 on the third day, and 10,000 on the seventh day. Cough and expectoration continued two weeks after subsidence of fever.

Roentgen films showed the disseminated type of disease (Fig. 1D). There was generalized involvement of the entire right side of the chest and some increase in lung markings in the left base. The condition gradually cleared.

Station Hospital
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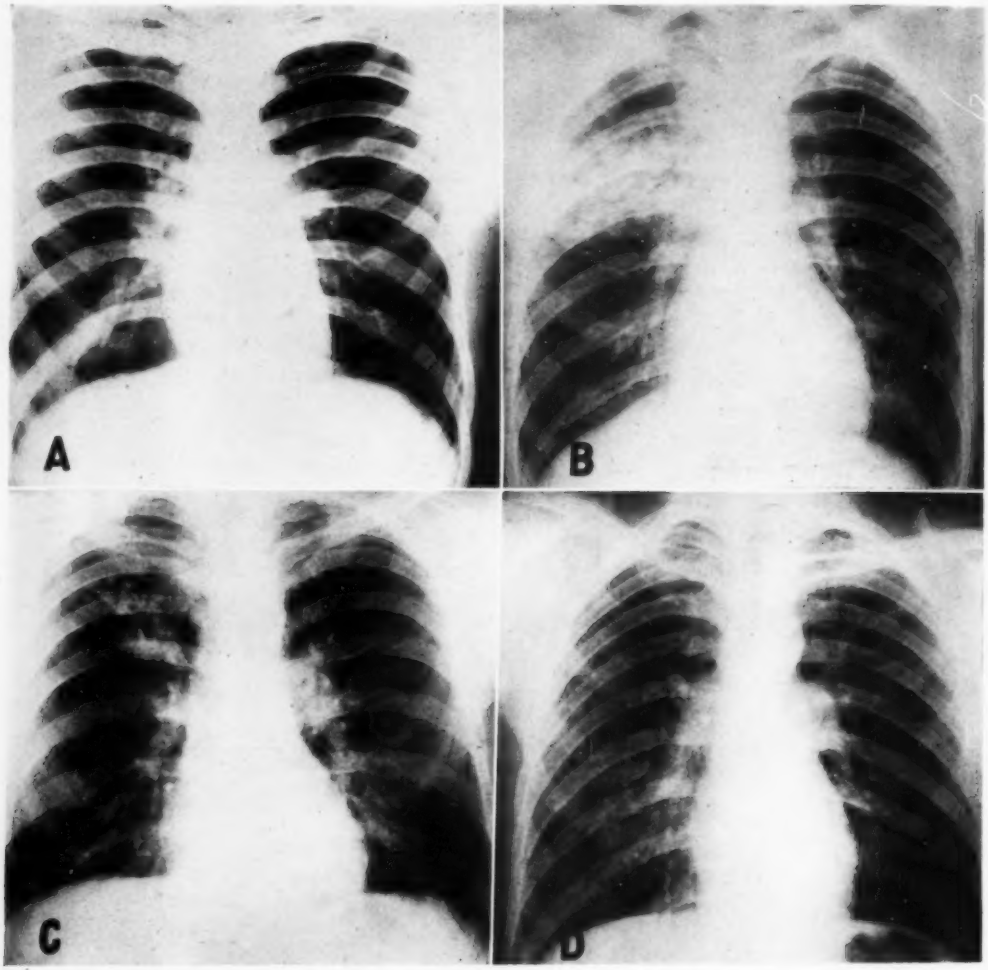

Fig. 1. Illustrative examples of primary atypical pneumonia. A. Group I. B. Group II. C. Group III. D. Group IV. For case histories, see text.

this type is the rapidity of the initial resolution. In *Group III* the findings consist of extending infiltrations radiating from the hilus region and subsequently extending to involve an entire lobe. This type is almost indistinguishable from tuberculosis, particularly when either upper lobe is involved. It is in this group that serial films have been most valuable, clearly indicating the true diagnosis. *Group IV* cases show increased lung markings throughout, with involvement of one side of the chest or more by small parenchymal areas of infiltration, somewhat resembling miliary tuberculosis. Patients in this group are extremely sick and the course of the disease is prolonged.

Though we have become rather used to the appearance of this disease in the roentgenogram, we have learned to be cautious with lesions in the upper chest. The distinction between an upper chest atypical pneumonia and tuberculosis is difficult. Observation of the patient and subsequent roentgen studies lead to the true diagnosis.

Primary Atypical Pneumonia of Unknown Etiology[1]

PAUL V. McCARTHY, Lt. Col., M.C.

SINCE THE OPENING of the hospital at which the writer is stationed there had been, to Nov. 1, 1942, 590 admissions of patients affected with a respiratory disorder that has been classified as primary atypical pneumonia of unknown etiology. These cases are apparently of similar nature and probably of the same origin, and we have come to look upon this condition as a disease entity.

This disease is an acute respiratory infection, probably transmissible by contact, occurring at all seasons of the year, characterized by chilliness, fever, cough, chest pain, and varying degrees of prostration.

The mortality of this disease has been extremely low. In our large group of cases there has been but one fatality in which the findings at autopsy clearly substantiated the clinical diagnosis of primary atypical pneumonia as the primary cause of death. In this particular case we have two chest films, one made on admission and one the next day. The pathologist's description of sections through the areas of pneumonic density seen in these films is as follows: "The alveolar walls show a marked capillary congestion, with cellular infiltration by numerous large mononuclear cells, lymphocytes, plasma cells, and occasional polymorphonuclear leukocytes. The perivascular and peribronchial tissues are similarly involved. Over large areas the alveoli are filled with edema fluid. The bronchi show the findings of acute bronchitis. Diagnosis: Acute exudative interstitial pneumonitis."

These patients *as a group* have not been very sick. In some the discomfort was not severe enough to cause report for sick-call. In a number of instances the disease was identified as a result of examination of chest films made incident to other examinations. The average patient, after the first several days of illness, had a feeling of well-being quite out of proportion to the findings in the chest films and became afebrile and clinically well in a week's time. There has been seen an occasional case, on the other hand, in which the patient has been extremely ill, with evidence of severe pneumonia requiring all the energetic measures commonly used in that disease. Recovery, in comparison with the severity of the clinical symptoms, in the average case has been prolonged. It has been the practice in our hospital to hold the patient till the chest film appeared relatively clear. It was found that this measure reduced the incidence of individual recurrence.

ROENTGEN FINDINGS

About the fourth day of illness, evidence of the disease appears in chest films. The findings are variable and in our work we have attempted a classification based on the roentgen appearances. In *Group I*, comprising the largest number of cases, the first detectable signs are an increase in size of the hilar shadows, with one side usually predominating, and a generalized increased prominence of the lung markings. The next day the lung findings have reached their maximum. There is at this time definite evidence of pneumonic density involving one or more lobes with such distribution that the spread has the appearance of direct extension from the hilus region. The common characteristic of this lesion is a homogeneous area of parenchymal density, a density that is less than that seen in lobar pneumonia, through which lung markings are apparent. In *Group II* the lesion appears as a patchy involvement, usually confined to a single lobe, with confluent areas of density. The appearance is suggestive of bronchopneumonia. The remarkable thing about

[1] Presented, as part of a Symposium on Atypical Pneumonia, before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 1, 1942.

to be the formation of the hyalin-like membrane lining the alveoli. This membrane obviously interferes with the exchange of gases and produces a severe cyanosis. As mentioned before, the presence of this hyalin-like membrane was often encountered in the so-called influenzal pneumonia. The involvement of the alveoli in addition to the interstitial tissue changes may be responsible for the fatal outcome of some of these cases. As stated above, no virus studies were made in our cases. Thus, there is no proof that the pneumonia in these two instances was caused by a virus. However, the failure to demonstrate a causative bacterium, the involvement principally of the interstitial tissue of the lungs, and the cytologic elements of the inflammatory regions make it likely that the disease was due to a virus.

SUMMARY

The conditions designated as atypical pneumonia, interstitial pneumonia, and by various other terms are a single disease probably caused by a virus or rickettsial body. The lesion is principally an interstitial pneumonia characterized by the presence of monocytes, lymphocytes, and a few red blood corpuscles, though alveoli are also involved. It is likely, though purely presumptive, that most of the pneumonia epidemics at present, which have a very low mortality rate, show principally only this interstitial pneumonia. In the more severe cases, the alveoli are much more involved. The exudate differs from that of lobar or bronchopneumonia in that it consists mostly of mononuclear elements. The hyalin-like ring forming the inner lining of many alveoli is characteristic and explains the severe cyanosis and fatal outcome of the disease in some patients. The difficulties encountered in virus studies are stressed.

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For an excellent summary, with complete literature, see FINLAND, M., AND DINGLE, J. H.: Virus Pneumonias. New England J. Med. **227:** 342, 378, 1942.

Atypical Pneumonia of Probable Virus Origin[1]

C. E. HUFFORD, M.D., and A. A. APPLEBAUM, M.D.

Toledo, Ohio

EVIDENCE OF infective non-bacterial primary bronchopneumonia in man has become sufficient to establish its recognition as a clinical entity. Many reports of this type of disease have appeared in the literature in the past seven years. Epidemics, both small and great, have been reported from several sections of this country, England, France, Spain, and Hawaii. Most of these have occurred in schools, among hospital personnel, or in military groups.

An epidemic among the white troops stationed in Hawaii in 1933 was described as "acute influenza pneumonitis" by Major Albert Bowen, Medical Corps, U. S. Army, and reported in the *American Journal of Roentgenology* in August 1935 (3). Major Bowen pointed out that the condition occurred particularly during influenza epidemics and spoke of it as being more or less benign. He recognized it as a bronchopneumonia, but with certain features which characterized it as a distinct clinical entity. Most of the literature on the subject has appeared to carry this conception and most of the authors have tried to use descriptive names, such as acute pneumonitis (2), acute interstitial pneumonitis (19), primary virus pneumonitis (1), bronchopneumonia of unknown etiology (variety X) (10), atypical bronchopneumonia (14), benign circumscribed pneumonia (15), and many others.

More recently there appears to be a tendency to forego any desire to label these cases by descriptive terms and to classify them broadly under the heading primary atypical pneumonias. This seems logical until such time as more light can be thrown on the probable etiology of the infections.

In all the reports emphasis has been laid on the fact that the disease differs from the usual types of lobar and bronchopneumonia, both clinically and pathologically. In 1938 Reimann (16) suggested a filtrable virus as the probable etiologic factor. In the same year Stokes (21) and others attempted isolation of the etiologic agent from certain cases. A filtrable infectious agent was recovered from two patients, but was lost during passage in animals, and its identity as a filtrable virus was not established.

Considerable work has been done in the attempt at isolation of a virus and some progress has been made. Notable among recent studies are those recorded by Weir and Horsfall (22), who, using throat washings from a number of clinically typical cases, attempted unsuccessfully to infect a variety of animals, but were able, finally, to produce pulmonary consolidations in the mongoose by the isolated filtrable agent. Contact mongooses developed the disease from infected animals, and convalescent mongoose serum neutralized the agent, while normal mongoose serum did not. Weir and Horsfall also found that serum from human beings convalescent from acute pneumonitis neutralizes the agent, but serum obtained in the acute phase of the disease does not.

There have been other noteworthy successes in the isolation of a virus in certain atypical pneumonias. Eaton, Beck and Pearson (6), for example, in 1941 obtained a virus which in certain characteristics resembled the virus of psittacosis. More recently Stickney and Heilman (20) isolated a somewhat similar virus from an atypical pneumonia in a man who had been exposed to feathers and droppings from pigeons.

[1] From the Department of Roentgenology (John T. Murphy, M.D., Director) St. Vincent's Hospital, Toledo, Ohio. Presented, by title, as part of a Symposium on Atypical Pneumonia, before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

In a recent article, Reimann, Havens, and Price (18) have emphasized the close relationship of several of the known filtrable viruses, all of which may cause "virus" pneumonia. Using the complement-fixation method of Meyer (12), they obtained "indirect evidence of infection with psittacosis virus or the related viruses of a psittacosis-like disease (ornithosis), meningopneumonitis, and lymphogranuloma venereum in four of eight cases of a condition regarded as 'virus' pneumonia. In one case the serum also gave strong protection against the virus of lymphocytic choriomeningitis."

No further progress, as so far we know, has been made in the isolation of a virus in the epidemic forms of atypical pneumonia which we are discussing.

In the past two years we have become aware of a form of atypical pneumonia which has exhibited certain clinical characteristics and objective findings indicating the existence of a common etiologic factor. The assumption that this is a disease attributable to a filtrable virus has been based on its similarity to many of the cases reported in the literature in the last seven years and on the definite clinical picture, which is similar in some respects to that caused by known filtrable viruses.

The syndrome, as we have observed it, has been characterized clinically by acuteness of onset, sore throat, severity of headache, generalized aching, drenching sweats, and severe coughing of a paroxysmal type. There has been evidence of a high degree of contagion by direct contact. In one group there were 4 cases traceable to one person, and in another group 6 cases.

The early physical signs have been conspicuously few. With the exception of some moist râles heard usually over the lung bases, and an occasional crackling râle, very little early demonstrable evidence of disease has been noted. The changes evident in the lung, as shown on the roentgenogram, in most instances far surpassed those anticipated from the clinical evidence. The leukocyte count was frequently found to be within normal limits or to show leukopenia. About forty per cent of the cases, however, showed a mild degree of leukocytosis at some time during the course of the disease. The differential counts varied little from normal. Sputum examinations failed in all cases to show any significant infective agent.

Three degrees of severity of the infection have been noted: (1) a mildly severe form; (2) a severe form showing large areas of lung involvement, with patients critically ill; (3) a migrating type with lesions spreading from one area to another.

Lack of any significant response to the sulfonamide drugs has been an outstanding characteristic of all the cases.

There has been one death in our series (27 cases), occurring during the compilation of this paper.

As stated above, the roentgen evidence of lung involvement was in most instances the outstanding objective feature of these cases. It must be emphasized, however, that the roentgen findings in themselves, apart from the clinical evidence, were in no case sufficiently characteristic to designate the case as definitely belonging to this group. In other words, the diagnosis could not be based on the roentgenographic findings alone, but in all instances the clinical findings and the history had to be taken into account.

The typical roentgen picture is that of diffuse, irregular, patchy densities with feathery edges extending out from the hilus of the lung. Large areas of consolidation are not common, though some coalescence is usually present. It is at once evident to the trained roentgenologist that such a description might readily apply to any one of a number of types of pneumonic involvement, but only in correlating the roentgen findings with the clinical evidence do we add to our worth as consultants and contribute our bit to the ultimate etiologic diagnosis and classification of these cases.

CASE REPORTS

The following five cases have been chosen from our series as characteristic examples of the various forms of atypical pneumonia. Two of these showed a mild degree of severity, two are classed as severe, and one is of the migrating type.

CASE I: A. H., female, age 37. Illness began on Sept. 24, 1940, with chilliness, sore throat, fever, general aching, and severe headache, which was not relieved by the usual remedies. Two days later a severe, non-productive cough greatly aggravated the headache. Fever ranged from 99 to 102.5° F. Moist râles were heard over both lungs. There were no localizing signs. A chill followed on Sept. 29, with fever of 104° F.

The patient was admitted to St. Vincent's Hospital. Crackling râles were heard in the left base. Slight exertion caused dyspnea and coughing. Some mental confusion existed.

The leukocyte count was 7,700, with 52 per cent segmented and 14 per cent stab forms of polymorphonuclears. Further white blood cell counts were 6,100 and 7,450, with normal differential counts. Sputum typing for pneumococci gave no reaction with types 1 to 33 sera. Urinalyses were negative.

Roentgen examination on Sept. 29 showed a diffuse, irregular, patchy density extending out and downward from the left hilus. Some smaller areas were present on the right side. The density was of a soft infiltrative character distributed peribronchially.

Sulfapyridine was given but caused vomiting and had to be discontinued.

The temperature gradually subsided to normal on the fourth hospital day, and the patient was discharged on the eighth day. Cough existed for three weeks and exhaustion was prolonged.

Case I is an example of the mild group. The attending physician and two other contacts became ill with the same condition. Two of them were carefully studied and are included in this series. The third was followed in the home, without roentgen studies.

CASE II: Dr. A. A. A., male, age 35 years. Dr. A. was the attending physician for Case I. He saw the patient on Sept. 26, and again on Sept. 29, 1940. On Sept. 30 he awakened with chilliness, fever of 100° F., generalized aching, and headache. Symptomatic treatment by his physician resulted in no evident improvement. On Oct. 2 a distressing paroxysmal non-productive cough developed, with aggravation of the then intense headache. The temperature range was from 99 to 103° F. Some mental confusion was present. Electrocardiograms

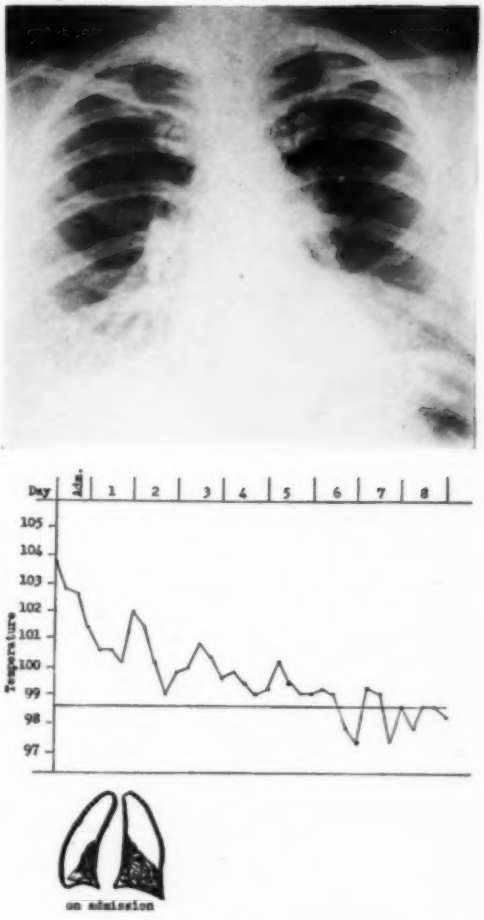

Fig. 1. Case I: Mrs. A. H. Roentgenogram, Sept. 29, 1940, showing irregular patchy density extending out and downward from left hilus. Smaller areas are present on right. Density is of a soft infiltrative character, distributed peribronchially.

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Four days later, Oct. 9, severe respiratory distress developed and the patient was admitted to St. Vincent's Hospital and placed in an oxygen tent.

The leukocyte count was 12,700, with 85 per cent polymorphonuclear cells. On the third hospital day the white blood cell count was 6,750 and thereafter remained around 7,000, with a normal differential count. Blood cultures were negative. Sputum typing for pneumococci with sera, types 1 to 33, was done twice and neither time showed a reaction. The urine showed no evidence of the presence of specific soluble substance of pneumococci with types

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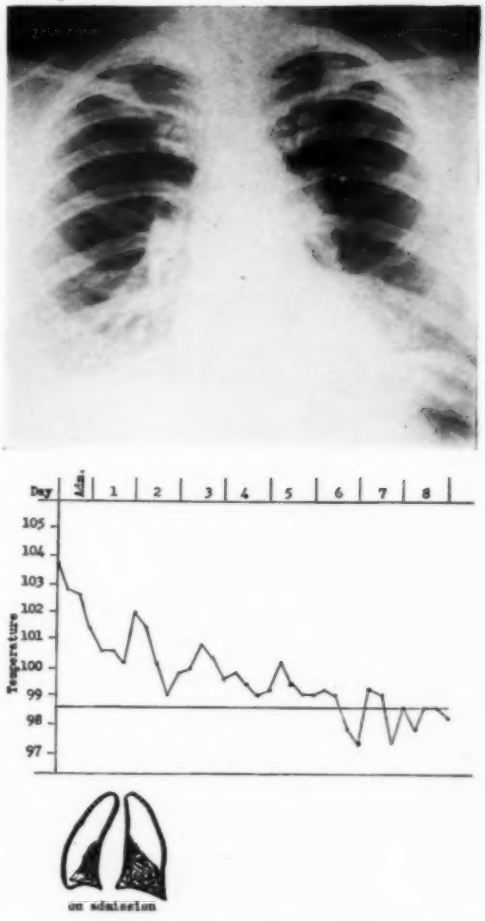

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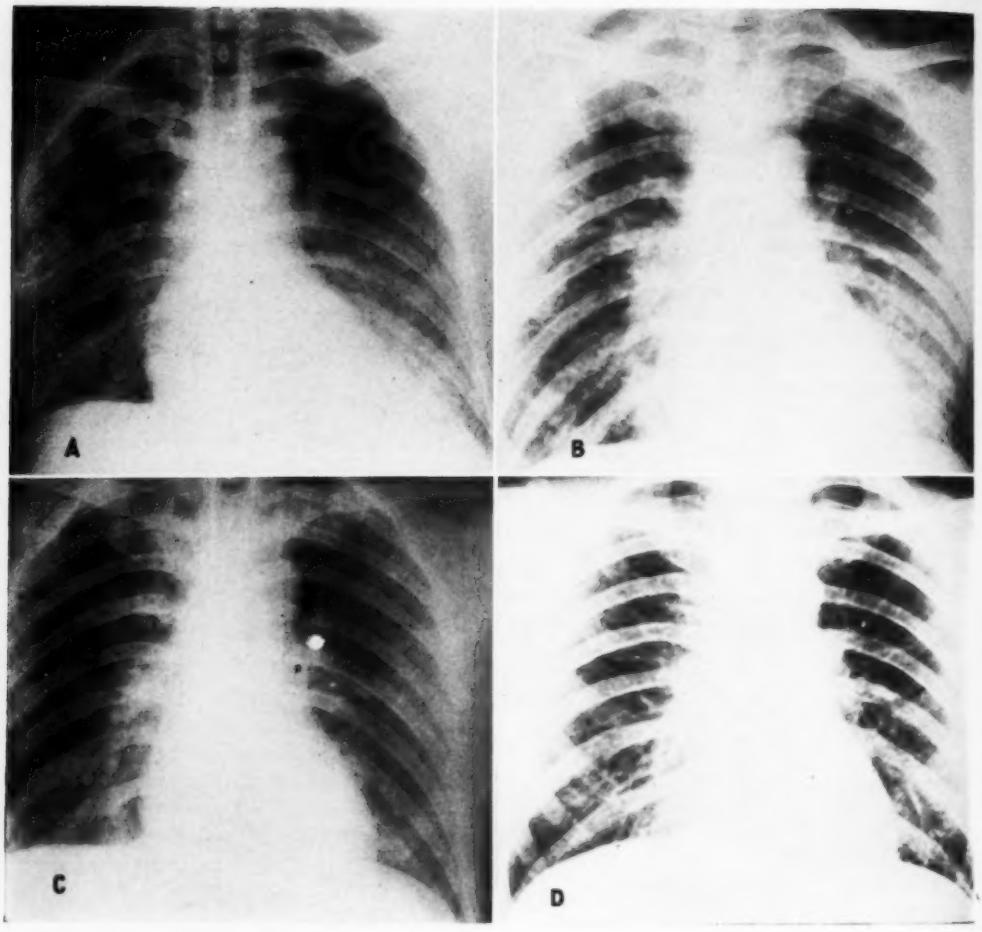

Fig. 2.—Case II: Dr. A. A. A. A. Roentgenogram, Oct. 10, 1940, showing generalized diffuse, irregular, patchy density with soft, feathery margins involving lower two-thirds of both lung fields. Density more uniform on left side.
B. Oct. 12. Improvement. More discrete areas on right.
C. Oct. 16. Some clearing in upper portions.
D. Oct. 26. Marked improvement. Almost complete clearing of both lungs.

1 to 33 sera. Sputum showed gram-positive cocci and rods. No acid-fast bacilli were seen.

Roentgen examination, Oct. 10, showed a generalized diffuse, irregular, patchy density with soft feathery margins involving the lower two-thirds of both lung fields. This extended out from the hilus regions, slightly higher on the right and somewhat more uniform on the left.

Subsequent roentgen examinations were carried out as follows: on Oct. 12 showing definite improvement throughout, with more discrete areas on the right; on Oct. 16, showing some clearing in the upper portions, with multiple small areas of consolidation still present; on Oct. 26, showing great improvement, with almost complete clearing of both lung fields; on Nov. 7, when complete clearing had occurred.

The temperature gradually subsided from 103.4° F. to normal on the fifth hospital day. Cough and dyspnea were very severe, and slight exertion precipitated paroxysms of coughing. The exhaustion was intense, and heavy sweating lasted until the temperature subsided. The patient was kept in an oxygen tent six days. He left the hospital on the nineteenth hospital day but the cough persisted for four more weeks.

Case II is representative of the severe types of the disease.

CASE VI: B. R., female, age 46, mother of a boy of three years and a half, the fifth case in our series. On Dec. 19, 1941, one day subsequent to the boy's return from the hospital, the mother experienced chills, fever of 100° F., sore throat, generalized aching, exhaustion, and intense headache. Severe non-productive cough followed, gradually becoming worse.

The patient was admitted to the hospital on Dec. 22, with crepitant râles in the right interscapular area, occasional loud râles, groans, and squeaks over both lung areas. The leukocyte count was 5,150 with 65 per cent segmented forms, 4 per cent stab forms, 28 per cent lymphocytes, and 3 per cent monocytes. Six subsequent counts ranged from 5,000 to 10,000, with normal differential counts. There were repeated negative urinalyses. No sputum was obtained.

A roentgenogram on Dec. 23 showed pronounced thickening about the right hilus. There was some peribronchial and perivascular thickening in both bases, extending out somewhat further on the left. The left costophrenic sulcus was obliterated. Sulfadiazine was given without remarkable response. On the fourth hospital day dullness was noted in the right interscapular area, with numerous crepitant râles present. There was some decrease of resonance in the left base.

A roentgenogram, Dec. 27, showed an increase of density of patchy character in the left base, not previously present. Hilus thickening was increased.

On the sixth hospital day the temperature dropped to normal, with several subsequent spikes to 101° F. Paroxysmal coughing occurred on exertion; dyspnea and exhaustion persisted. The patient remained in the hospital twenty-six days. Her recovery of strength was very slow.

A roentgenogram made two months later, Feb. 19, 1942, showed some prominence of bronchovascular markings. The findings were otherwise negative.

Case VI is of the migrating type. A son and a daughter of the patient, home on vacation, both became ill with similar symptoms on return to their schools in the East. Two attending nurses also became ill with a similar infection. One of these is included in this series.

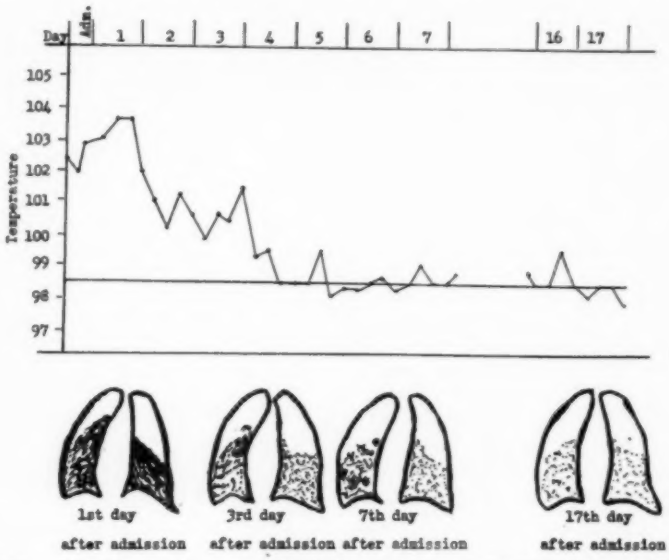

Fig. 2E. Case II: Dr. A. A. A. Hospital record of temperature and lung findings.

CASE IX: W. C., male, age 52, became ill on Jan. 10, 1942, with a chill, fever, aching, and exhaustion. This was followed in two days by severe non-productive coughing and drenching sweats. Sulfathiazole was administered without benefit.

The patient was admitted to St. Vincent's hospital on Jan. 20, apparently moribund. There were diffuse crepitant râles over both lungs. The white blood count was 17,800, but the patient was greatly dehydrated. Nine subsequent counts were made, ranging from 5,600 to 10,000. The sputum showed no tubercle bacilli and no pneumococci. Urinalyses were negative.

A roentgenogram, Jan. 20, showed a diffuse increase of density extending out from the hilus regions and involving almost the entire left lung and the right upper lobe.

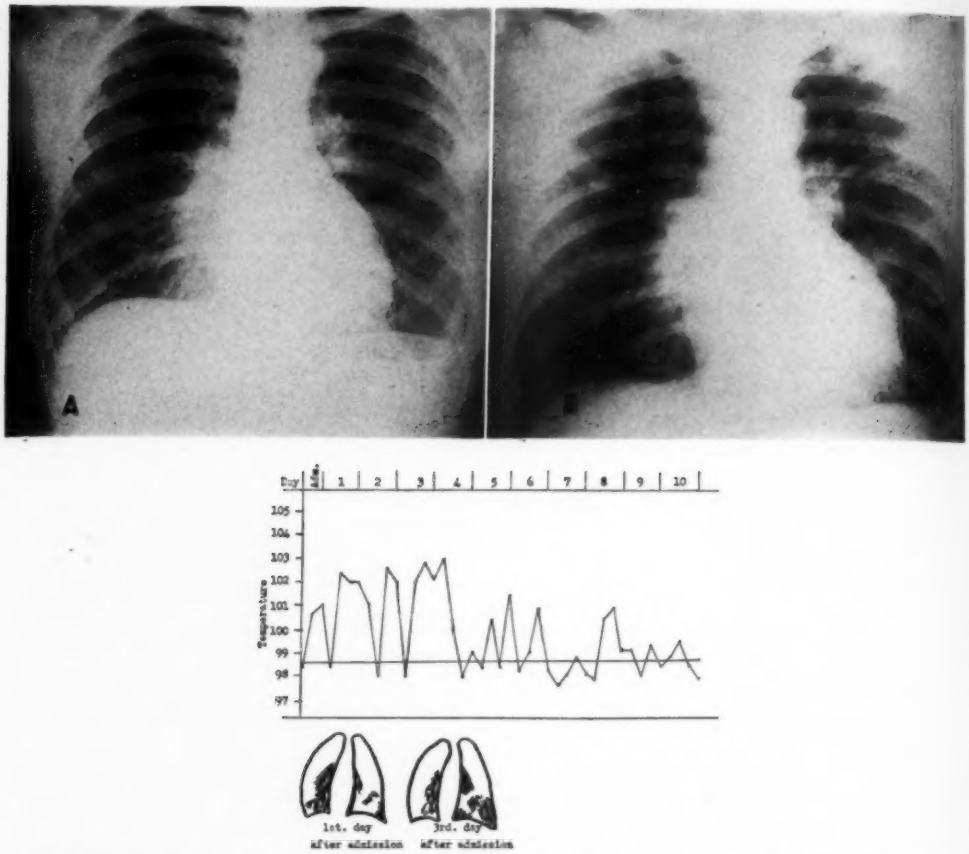

Fig. 3. Case VI: Mrs. B. R. A. Roentgenogram, Dec. 23, 1941, showing thickening about the right hilus and some peribronchial and perivascular thickening in both bases. The left costophrenic sulcus is obliterated.
B. Dec. 27. Patchy density now present in left base; hilus thickening increased.
The hospital record of temperature and lung findings is shown in the lower cut.

Sulfadiazine was given, with no benefit. Four blood transfusions were given. The patient was kept in an oxygen tent for twelve days, at which time his temperature dropped to normal.

The preceding case belongs to the severe group. The patient was the most seriously ill of all who recovered.

CASE XIV: Dr. A. P. N., male, age 29, a resident physician in medicine, became ill on Feb. 3, 1942, with chills, a temperature of 102° F., generalized pains and aches, severe headache, and sore throat. Two days later a chill was followed by temperature of 103.5° F. and severe paroxysmal, non-productive coughing and drenching sweats. There were a few crackling râles in the right interscapular region and occasional moist râles over both lung areas. On Feb. 6 the patient was admitted to St. Vincent's Hospital. The white blood cell count was 11,500 with 82 per cent polymorphonuclears. Five other white blood cell counts ranged from 5,700 to 8,500. Differential counts were normal. Urinalyses were normal. The sputum showed a few gram-positive diplococci, gram-negative rods, and gram-positive cocci in short chains.

A roentgenogram, Feb. 6, showed a large zone of confluent patchy density extending out and upward from the right hilus and apparently involving almost the entire upper lobe. The left lung was relatively clear. Two weeks later, Feb. 20, a roentgenogram showed complete clearing of the process.

Sulfadiazine in therapeutic doses was given. The temperature dropped to normal on the fourth hospital day and remained so. Drenching sweats persisted five days. The patient was mildly confused on the day of admission to the hospital. His headache subsided on this day. His cough gradu-

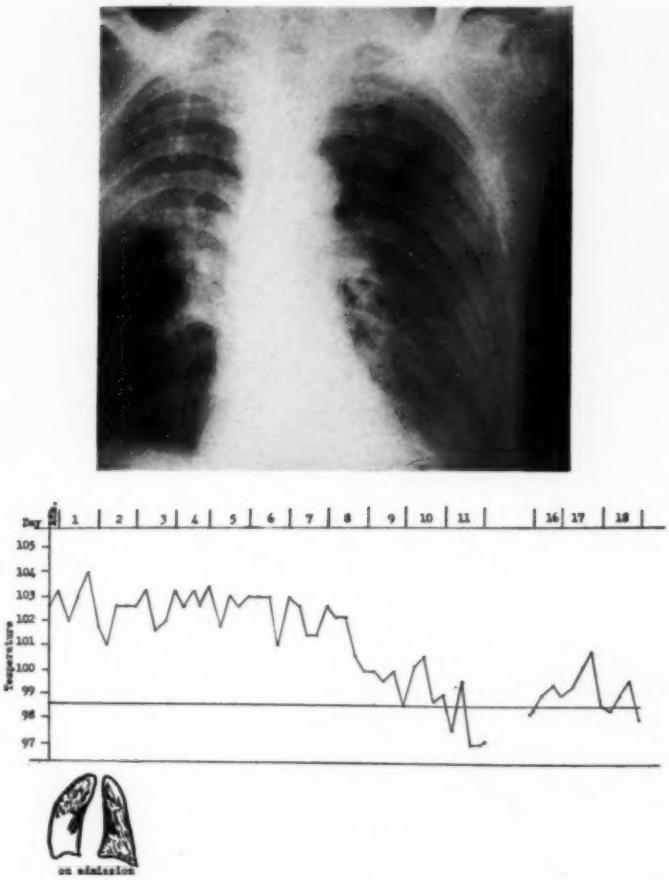

Fig. 4A. Case IX: W. C. Roentgenogram, Jan. 20, 1940, showing diffuse increase of density extending out from both hilus regions, involving the right upper lobe and almost the entire left lung. The lower cut shows the hospital record of temperature and lung findings.

ally subsided. He left the hospital on the fourteenth day.

This case was of the mild type. On the first roentgenogram tuberculosis would have to be considered in the absence of a history.

DISCUSSION

Twenty-seven cases have been observed in the past two years which have presented clinical symptoms, physical findings, and objective evidence of such a type and such similarity that they have been labeled atypical pneumonias of probable virus origin.

There were 15 females and 12 males, ranging in age from three and a half to sixty-four years, with the majority between twenty and fifty years of age.

The outstanding clinical symptoms were headache, sore throat, chills and fever, general aching, drenching sweats, exhaustion, and paroxysmal non-productive cough. All but 2 of the 27 patients experienced severe headaches and only one of the series escaped the paroxysmal non-productive coughing.

The most characteristic physical finding was the presence of moist râles at the bases of the lungs posteriorly. Occasional crackling râles were noted in many cases, but percussion changes were conspicuously ab-

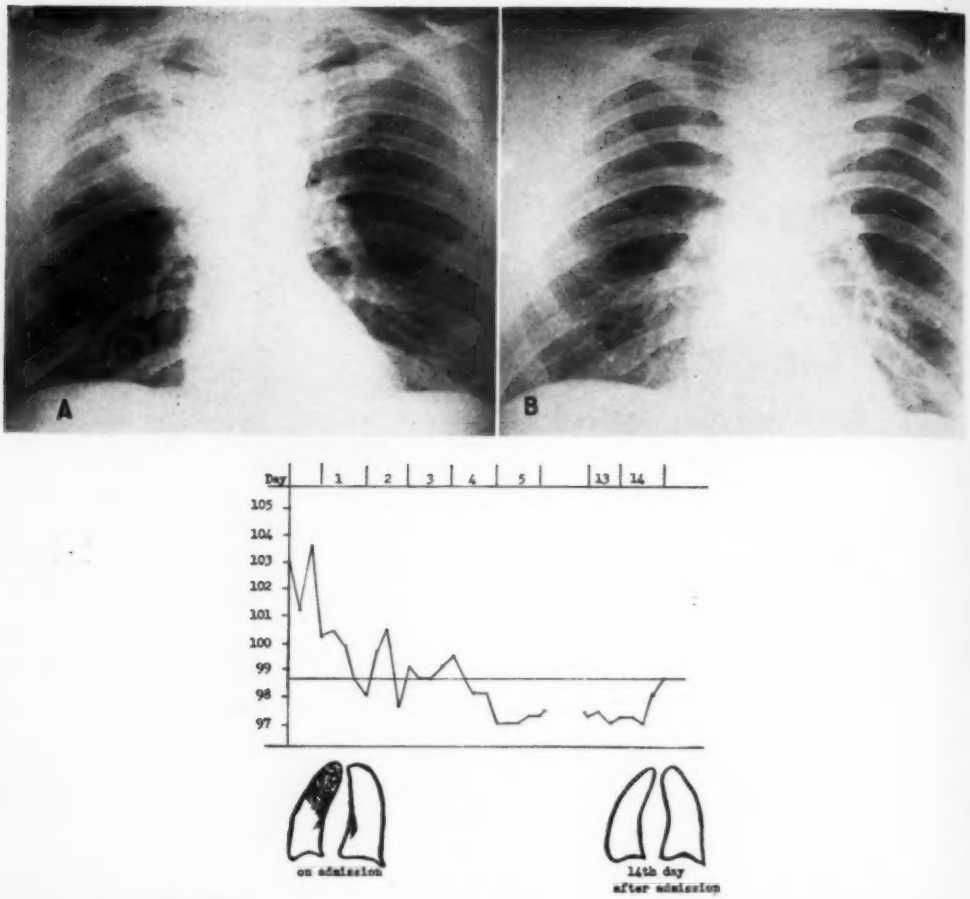

Fig. 5. Case XIV: Dr. A. P. N. A. Roentgenogram, Feb. 6, 1942, showing zone of confluent patchy density extending out and upward from the right hilus, involving almost the entire upper lobe. Left lung relatively clear.

B. Roentgenogram made Feb. 20, two weeks later. Complete clearing of the process. The hospital record of temperature and lung findings as shown in the lower cut.

sent. In 4 instances some impairment of resonance was present in the interscapular areas and there was definite dullness to percussion in one case.

In 15 cases the initial leukocyte counts were below 9,000 and in 7, or 46 per cent of these, the first counts were below 7,000.

In the 12 cases in which there was an initial leukocytosis, the highest leukocyte count was 17,800. Subsequent counts showed a definite tendency to leukopenia with 50 per cent of those showing high counts at the outset dropping rapidly below 7,000.

The differential counts were within normal range throughout the series.

Sputum typing was done in 5 cases, and in none was a reaction obtained with pneumococci sera from 1 to 33. In one case the urine was tested for pneumococci soluble substance and produced no reaction with pneumococci sera from 1 to 33.

Bacteriological studies were made on sputa from 7 cases. The most common finding in these was gram-positive cocci in short chains and clusters. No pneumococci were found and no acid-fast bacilli were discovered.

Roentgenographic studies were made in all cases and multiple subsequent films were taken in 12 of the series.

Various sulfonamides were tried in therapeutic doses. Sulfadiazine was used in 11 cases with apparent good response in a single instance. Sulfathiazole was used in 6 cases. Sulfapyradine and sulfanilamide were used in one case each. Sulfadiazine, sulfathiazole, and sulfanilamide were all three used successively in one case, without favorable response. Three subsequent reactions with rashes followed the administration of the sulfonamide drugs.

Oxygen tents were used in 3 instances.

Whole blood transfusions were given in 3 cases. Whole blood and blood plasma from donors recently recovered from "virus" pneumonia were given in one case. Temporary improvement followed administration of the convalescent whole blood and plasma. This patient died, however, after one month's illness. Further studies of complications in this case are being conducted.

General symptomatic treatment was employed with uniformly good response in all but the final case of the series. This was the one fatal case in the group.

Classifying the cases as to severity of illness into mild, severe, and migratory types, 66.0 per cent were of the mild type, 18.5 per cent were in the severe group, and 15.5 per cent were of the migratory type.

The element of contagion in these cases is evident in the fact that the second and third cases of the series were direct contacts with Case I. To the youngest patient in the series, a boy three and one-half years of age, 5 other cases were directly traceable.

In the absence of any proof of a filtrable virus as an etiologic factor in these cases, the diagnosis in all instances was dependent on a close correlation of the clinical symptoms, physical findings, and roentgenographic evidence. In no instance was the roentgenologist sufficiently confident of his interpretation of the film findings to offer more than a suggestion of virus etiology. In all cases the diagnosis resulted from close co-operation between the internist and the roentgenologist.

In at least 2 instances, had the roentgenologist been left without benefit of the clinical observations, tuberculosis would have been placed at the head of the list in the differential diagnosis.

The roentgenographic findings, though strikingly similar and characteristic throughout the series, must in all instances be correlated with the clinical picture to be of value in classifying these cases.

The recognition of this series of cases, together with several others of similar character less thoroughly studied in the past two years, draws attention to the probability of the existence of many such cases.

SUMMARY

1. Atypical pneumonia of virus origin, some types proved, others unproved, is now recognized as a distinct clinical entity.

2. The clinical and roentgenologic characteristics of a group of 27 cases are discussed.

3. Roentgenologic evidence in most cases is far more extensive than early clinical findings would indicate.

4. Leukocyte counts were frequently normal or showed a tendency to leukopenia.

5. Sputum examinations showed an absence of any significant infective agent.

6. A definite factor of contagion is evident in the series.

7. Sulfonamides had no significant effect on the course of the disease.

8. There was one fatality in the series of 27 cases.

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DISCUSSION OF SYMPOSIUM ON ATYPICAL PNEUMONIA

(Papers by Paul S. Rhoads; Otto Saphir; P. V. McCarthy; Francis C. Curtzwiler and B. E. Moore; Clarence E. Hufford and A. A. Applebaum)

A. Fine, Capt., M.C. (Cincinnati, Ohio): I want to ask if any of these patients have been tested for coccidioidomycosis. This we know is endemic in certain parts of the country and in our work we see men from all sections. I think some of the cases we have encountered may have been of coccidioidal origin, although we have not had the opportunity to test for the organism. We have seen a good many films of coccidioidomycosis and some of them are indistinguishable from the type of pneumonia described in this symposium

J. R. Maxfield, Jr., M.D. (Dallas, Texas): I had the opportunity in 1938 and 1939 of reporting on cases very similar to those which have been described. Colonel Bowen and a number of others recognized this entity at about the same time. It seems that a series of epidemics occurs; then there is a lull in the intensity of the infection. I have been following the subject since presenting my original paper in 1939, and during the time I have seen several hundred cases

I would like to know if those in different parts of the country have had the same experience as I. In the first place, the sulfonamides seem to have no effect on the disease. Blood transfusions offer the best therapeutic agent but most cases require only supportive treatment.

In the second place, I have yet to see a case prove fatal unless there was a definitely demonstrable secondary infection with a resultant high leukocyte count. Also of importance in my series is the fact that the x-ray findings do not parallel the physical findings or the clinical course of the disease. My sickest patients have been those with small hilar infiltrations with no physical signs. The period of general malaise, the duration of the disease, and its communicability, as discussed in the papers here presented, are in full accord with my experience.

At the time I presented my paper I did not know exactly what to call this condition, but it seems that "atypical pneumonia" is still holding the lead. Colonel Bowen and several others use the designation "virus pneumonitis of the interstitial type" and claim that the term "pneumonia" should be discarded. A correlation of all studies on this problem will be necessary before we can definitely establish this disease in its proper place in our nomenclature.

Erich Uhlmann, M.D. (Chicago, Ill.): I would like to add a few words to this interesting and important subject. While there seems to be general agreement on the classification of this type of pneumonia into a special group based on definite diagnostic findings, there is a complete lack of suggestions

for adequate therapy. Symptomatic treatment is recommended and it is admitted that the sulfa drugs are not effective in these patients.

In February of this year I was asked for the first time to treat with x-rays a patient who was suffering from so-called "virus" pneumonia, and this therapy proved to be extremely successful. As you know, x-ray therapy for pneumonia has been used for a long time; but in the last four or five years we have not been called upon for such treatment, obviously because there was no need for it as long as these patients could be successfully treated with sulfa drugs. But patients with atypical or virus pneumonia are resistant to sulfa drugs and it has been gratifying to watch the reaction of this type of pneumonia to x-ray therapy. We have treated about 50 patients since February, and in most instances the effects of radiation therapy were dramatic. The temperature went down to normal in a short time and respiration and pulse rate improved quickly. The treatments were given daily or with a one-day interval and, as a rule, not more than two treatments were necessary to achieve the desired effect. In some patients three treatments had to be administered.

The x-ray treatments were given over the site of the lesion, the field size depending on the extent of the involved area. With 200 kv., and 1.0 mm. Cu plus 0.5 mm. Al filtration, 75 to 100 r units were given at 50 cm. distance in each treatment.

While the clinical symptoms improved immediately following application of x-rays, it usually took more time to show demonstrable changes in the films. While some patients showed rapid clearing of the lung symptoms, in others eight to fourteen days were required before there was evidence of complete resolution of the consolidation.

Doctor Rhoads: In our one fatal case, which I did not have time to talk about, the only organism cultured was *Streptococcus viridans*. It is impossible to be sure that this secondary invader was the cause of the pneumonic infiltration with polymorphonuclear leukocytes which was found at autopsy. I believe, however, that this man had streptococcic pneumonia superimposed on a "virus" pneumonia. He started out with a normal leukocyte count, and it reached 26,000 before he died. Most of the patients who have secondary invaders eventually have a leukocytosis.

In reviewing the reports of others who have had one or more cases with fatal termination, I have been impressed with the fact that most of these cases showed leukocytosis of a high degree. Often, the writers have reported culturing organisms from the lungs at autopsy, which they did not deem to be of much importance. Kneeland, for instance, reported Type X pneumococcus in the lungs in his fatal case. In Illinois, this organism has caused a highly virulent type of pneumococcus pneumonia.

Colonel McCarthy: This problem has been of serious concern to the Army. At the request of the Surgeon General, members on the Advisory Commissions on influenza and pneumonia have been devoting special attention to this disease since the spring of 1941. At that time members of these Commissions came to our hospital and, with the aid of a laboratory set up by the 4th Corps Area Headquarters, studied all the cases that occurred over a period of three months. Great amounts of material were collected and studied, and I understand the work is still in progress.

A thorough bacteriological study was made of all the cases mentioned and, so far as the Commissions are concerned, none of the various cultures that they gathered and worked with contained any agent that could be held responsible for this disease. In addition they proved definitely that these cases are not influenza A or B nor Q fever. Nor have they, so far as I know, identified any other virus as the causative agent.

This work will be reported upon later. Whether or not these investigators will be able to isolate a virus as the causative agent of this disease remains for future study to indicate.

The Army was at first concerned as to whether this disease might be the forerunner of a recurrence of influenza of 1918. When we first saw these cases we often referred to them as the "flu." In view of the work I have just mentioned, this diagnosis is not acceptable for these cases in Army nomenclature.

Major Curtzwiler: I think Doctor McCarthy has answered the question concerning coccidioidomycosis. I have discovered no such cases in our series.

Concerning x-ray treatment, I did have the idea of using this in atypical pneumonia and did so on three or four occasions. Our patients, however, were not seriously enough ill to reveal a great deal of benefit from it, and because of the fact that the x-ray department at the Station Hospital at Camp Davis is very busy, I had to discontinue the series.

Echinococcus Cyst of the Lung[1]

WILLIAM A. EVANS, JR., M. D.

Detroit, Mich.

ECHINOCOCCUS disease is rare in North America and the pulmonary manifestations are not generally appreciated by roentgenologists. In the past decade the disease has been thoroughly studied, particularly in South America and French Africa, and certain valuable diagnostic and prognostic features in the roentgen examination have been established. They may be of interest to radiologists working abroad, where the disease is more often encountered. It is said to be most prevalent in Australia, Iceland, North Africa, and South America.

The present case is reported as it illustrates a pathognomonic roentgen sign of a pulmonary hydatid cyst.

R. DeL., an Italian boy, 12 years of age, was admitted to the Children's Hospital of Michigan on March 16, 1942, complaining of a pain in the left side of the chest and a non-productive cough of ten days' duration. He had lived in Italy for seven years. In addition to the pain and cough, there had been some loss in weight, weakness, and pallor for six months. He was thought to have had a similar attack of pain, cough, and fever in the preceding year.

Fig. 1. Roentgenograms exposed in postero-anterior and right lateral projections, showing the large ovoid mass of the hydatid vesicle separated from the capsule of adventitia by a crescentic air space superiorly and to a lesser extent inferiorly also.

The results of physical examination were not remarkable except for some dullness of the percussion note in the left chest posteriorly with diminished breath sounds and fine râles. There was no fever, and the usual laboratory studies were negative. No eosinophilia was present.

The x-ray examination, on March 16, 1942, disclosed a sharply circumscribed shadow in the left mid-chest posteriorly, measuring 10.5 × 8.5 cm. (Fig. 1). The shadow was of uniform density except for the appearance of a capsule at the periphery, with a layer of air between the capsule and the mass itself. This phenomenon was not explained and a presumptive diagnosis of a benign tumor was made.

[1] From the Children's Hospital of Michigan, Detroit, Michigan. Accepted for publication in November 1942.

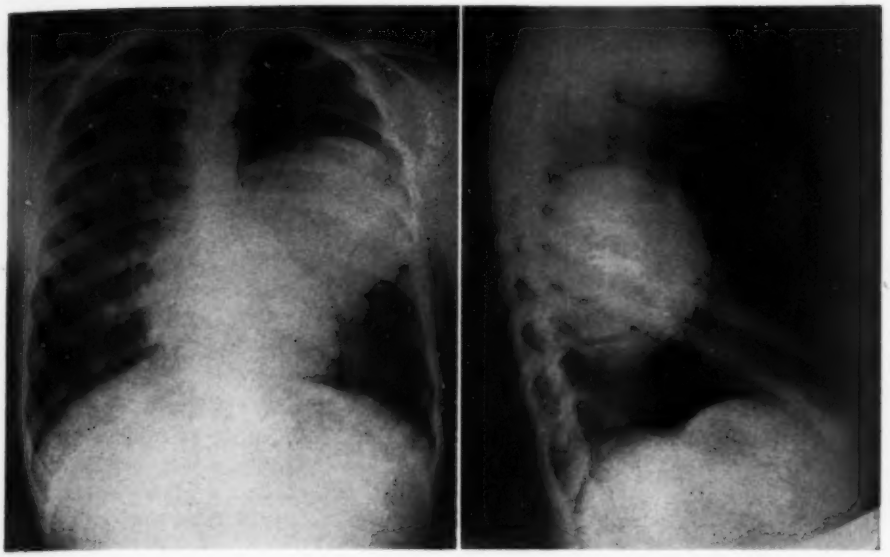

Fig. 2. Re-examination, following the introduction of a pneumothorax on the left. The air space beneath the capsule has disappeared.

Upon re-examination one week later, following the production of a diagnostic pneumothorax, the air beneath the capsule was no longer seen (Fig. 2). The mass appeared to be separate from the parietal pleura at the lateral chest wall. At a third study, immediately preceding operation, the pneumothorax had disappeared and there was again no sign of a capsule or any other differentiating shadow within the mass.

On April 4, 1942, the patient was operated upon by Dr. Clifford D. Benson and Dr. Grover C. Penberthy. The left pleural cavity was exposed following removal of a portion of the seventh rib. There were a few adhesions between the visceral and parietal pleura posterolaterally, which were easily separated, and a cyst was found in the periphery of the left lower lobe. The cyst was covered by lung except in a small area where there was a thick membrane. This was incised and through the opening an intact cyst was delivered. With the cyst removed, a small bronchial fistula was seen in the depth of the pouch which had contained the cyst. The thick fibrous walls of the pouch were then removed and the defect, together with the fistula, was obliterated by suturing the pulmonary tissue. The postoperative course was satisfactory, and the patient was discharged from the hospital in good condition on May 8, 1942.

The pathological examination was made by Dr. Wolfgang W. Zuelzer. The intact cyst was of oval shape, measuring 10 × 8 × 8 cm. The outer surface was smooth except for some fine threads of fibrin. Within a few minutes after its removal, the cyst ruptured spontaneously discharging about 200 c.c. of clear fluid containing a heavy sediment which settled rapidly. The microscopic examination of the sediment showed it to consist of echinococcus taeniae with well preserved scolices, and in examination of the cystic membrane they were observed attached to the inner surface. The wall of the pouch which contained the cyst was composed for the most part of dense collagen, but there were also small areas identified as compressed bronchioles and atelectatic alveoli. There was no outer limiting membrane separating the adjacent lung.

HISTORICAL ASPECTS

Echinococcus cysts of the lung during the course of their development and disintegration exhibit an interesting variety of roentgenographic manifestations, some of which are quite pathognomonic. The description of the radiographic appearance of pulmonary echinococcus disease goes back at least as far as 1899, when Levy-Dorn and Zadek (1) reported a case and differentiated between the simple unruptured cyst and one which had been evacuated. The classic description of a simple echinococcus cyst as a rounded shadow of uniform density and sharp outline in a clear pulmonary field is usually ascribed to M. A. Béclère (1903), who considered this picture as pathognomonic (2). In this

stage of development of the cyst, however, a positive roentgen diagnosis cannot be made, for differentiation may be impossible from neoplasms such as sarcomas, either primary or secondary, chondromas and osteomas, as well as carcinomas, neurinomas, and fibromas. Rarely certain inflammatory granulomas, such as the gumma of syphilis, dermoids, and other congenital cysts, lymphogranulomas and even aneurysm may produce a similar appearance.

As the echinococcus cyst increases in size, the circular contour may be deformed through the resistance offered by the chest wall, the diaphragm, or the bronchi. Escudero (3) and later Nemenov (4) observed that hydatid cysts in contrast to solid tumors may change their shape during respiration, and this manifestation is known as the sign of Escudero-Nemenov. Large cysts tend to produce an enlargement of that portion of the thorax in which they lie, with displacement of the mediastinal structures to the opposite side. This behavior is in contrast to that of tumors, which are more apt to produce massive atelectasis and contraction of the chest, and is referred to as the sign of Querilo-Walsch (3). Cysts in contrast to aneurysms do not produce erosion of bone. The outline of the cyst is not always sharp, and particularly in older cysts there may be varying degrees of inflammation and atelectasis in the lung adjacent to the adventitia of the cyst, giving an indistinct feathered outline. If the pleura is near the cyst, a marked pleural reaction may develop. Although the adventitia may become very dense and sclerotic, it rarely becomes calcified, in contrast to hepatic hydatids.

As the cyst enlarges, bronchial communication may develop in the adventitia and upon coughing or other forceful expiration a small amount of air may enter the space between the membrane of the hydatid vesicle, which is part of the parasite proper, and the adventitia, which is formed by the host. Like the intrapleural cavity, this space is originally present as potential only. According to Dévé (5), the great French authority on echinococcus disease, this manifestation of air between the membranes was first observed roentgenographically by Zehbe (6) in 1916. It was subsequently described by others, but its significance and diagnostic importance were not appreciated until interest was aroused by the reports of Caeiro and Goyena of Buenos Aires in 1933 (7) and independently of Morquio, Bonaba, and Soto of Montevideo in 1934 (8). The latter group, which had observed 5 cases in about two years, gave the designation perivesicular pneumocyst to the phenomenon and recognized that it was reversible. The parasite remains intact with no escape or alteration of the contents of the cyst fluid. Belot and Peuteuil (9) reported the condition from Algiers in 1936 as the "sign of detachment," and reports were also published by Nguyen-Dinh-Hoang (10), Costantini and Le Génissel (11), Guarini (12), Ivanissevich and Ferrari (13), Cantonnet Blanch, Charlone, and Barberousse (14), Chifflet and Purriel (15), Brun, Jaubert de Beaujeu, and Bège (16), Andrade (17), Rivas and Gobich (18), and others. Ivanissevich and Ferrari were able to produce the phenomenon experimentally by insufflating the trachea of a sheep affected with pulmonary echinococcosis. Chifflet and Purriel observed that the sign may be brought out only on deep inspiration. Other terms used for the phenomenon are *camara aerea* or air chamber, *calotte aerienne* or air cap, crescent image, periparasitic emphysema, pneumoperihydatid, and pericystic emphysema. The phenomenon is generally regarded as a rare manifestation of pulmonary echinococcosis but quite pathognomonic when it does occur. Costantini and Le Génissel found it in only 3 of 100 cases reviewed by them. Dévé (5) observed a similar picture in a case of aspergillosis in which a mass of fungi, a mycelial calculus, almost filled a large bronchiectatic abscess leaving only a thin layer of air. The mass, however, did not have the hair-line sharpness of a hydatid vesicle and he regarded his case as "an ex-

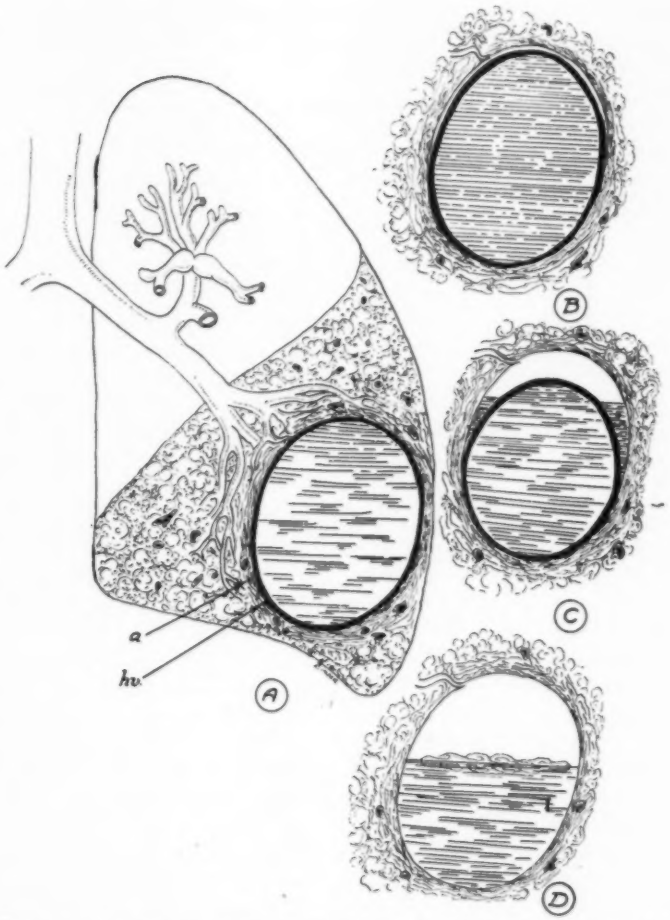

Fig. 3. Diagrammatic representation of the stages in the disintegration of a pulmonary hydatid cyst. *a*. Adventitia containing atelectatic alveoli and compressed bronchioles. *hv*. Hydatid vesicle with its wall in close apposition to the adventitia.

A. At this stage the adventitia and hydatid vesicle are intact and a positive roentgen diagnosis can rarely be made. The signs of Escudero-Nemenov (a change in the shape of the shadow during respiration) and Querilo-Walsch (expansion of the involved area of the chest) may be helpful.

B. Air has entered the space between the adventitia and hydatid vesicle by means of a bronchial communication, producing the sign of detachment or perivesicular pneumocyst of Morquio, Bonaba, and Soto.

C. Further separation of the cyst and adventitia has occurred, and disintegration of the cyst has permitted leakage of the cyst fluid into the pericystic space. This is Cumbo's sign or the double arc sign of Ivanissevich.

D. The collapse of the cyst is complete and the retained membrane floats on the cystic fluid, producing the water-lily (*camalote*) sign of Segers and Lagos Garcia. At this stage the cystic fluid is usually secondarily infected and purulent. Expulsion of the fluid and membranes through a bronchus may occur during a severe paroxysm of coughing.

ception which proved the rule" concerning the pathognomonic validity of the sign.

Although the phenomenon of a pericystic air space is reversible, it usually indicates the imminent disintegration and rupture of the vesicle and the subsequent evacuation of the cystic fluid and membranes through a bronchus ("vomica").

This is well illustrated in the serial studies of cases reported by Costantini and Le Génissel (11). Presumably the detachment of the cyst results in impaired nutrition, leading to death of the parasite. As the fluid escapes from the cyst, a fluid level is formed in the pericystic space and the brood membrane falls away from the adventitia and is recognized in the roentgenogram as an arch between the adventitia and the fluid level. This stage was first described by Cumbo in 1921 (3) and hence is known as Cumbo's sign; later by Tillier in 1932 (19), Blefari Melazzi in 1933 (20), and by Ivanissevich and Ferrari (13), who referred to the roentgen appearance as the "double arc sign." Rivas and Gobich (18) observed the double arc sign three times in 150 cases encountered in a period of about twenty years.

When the cyst ruptures, the fluid becomes infected and the term pyopneumocyst is commonly used. As the vesicular membrane collapses further, it becomes an irregular mass floating on the fluid. This produces the "sign of the *camalote*" (a South American river weed of the family of the Iridaceae resembling a water lily) described by Segers and Lagos Garcia in 1924 (21). Differentiation from the common pyogenic lung abscess may be difficult at this stage. According to Tillier (19), the recognition of the retained membrane and the slow movement of the fluid on change of position, which is due to the presence of the membrane rather than actual viscosity of the fluid, permit the diagnosis of echinococcus disease. A final manifestation is the expectoration of the cystic fluid and fragments of the membrane, and the diagnosis can then be made upon identification of the hooklets or the membrane. The entire parasite may be evacuated in this manner and a spontaneous cure result.

SUMMARY

A case of echinococcus cyst of the lung in a child is reported. A pathognomonic roentgen manifestation due to the presence of air between the parasite and the adventitia was present. The cyst was removed intact and the patient recovered.

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Posterior Displacement of the Calcified Pineal in Subtentorial Brain Tumors[1]

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DISPLACEMENT of the calcified pineal gland is usually of considerable aid in localizing a brain tumor. For example, if the pineal is displaced upward, the lesion is probably beneath the pineal gland; if the displacement is lateral, the tumor is as a rule to the right or the left side. We have seen 3 cases, however, in which complete reliance on the type of shift would have given incorrect localization. These 3 patients had subtentorial (posterior fossa) tumors, but the shift in each case was posterior. A posterior shift appears to be paradoxical, as the pineal lies above and anteriorly on the tentorial shelf and could not be pushed backward by a tumor beneath it. Other authors (1, 3, 6) have described in subtentorial tumors a shift upward, laterally, or anteriorly, which are the logical directions when the tentorium is made to bulge by pressure from below. A posterior shift, on the other hand, cannot be due to direct pressure. We believe the pneumo-encephalographic finding of internal hydrocephalus gives the clue.

Examination of all the proved subtentorial tumors from the Neurological and Neurosurgical Services of the Massachusetts General Hospital from 1935 to May 1942, disclosed 16 cases with calcified pineal glands. Only 3 of these showed a shift in the lateral films, and in all 3 the displacement was posterior. In the other 13 cases of the series the pineal was not displaced.

The shift of the pineal was measured by the methods of both Fray (3) and of Vastine and Kinney (6). The posterior shift noted in the authors' 3 cases was confirmed by both methods.

[1] From the Departments of Radiology and Neurology, Massachusetts General Hospital, Boston, Mass. Accepted for publication in November 1942.

CASES

CASE 1 (U-314865): Epidermoid cyst: cholesteatoma. A 47-year-old housewife began to have occipital headache three years before admission, and ataxia, with falling to the left, two years before. For a short time she had noticed increasing somnolence and loss of memory. Examination showed bilateral papilledema, nystagmus, paresthesia of the right cheek, bilateral tinnitus, partial deafness and hypo-active labyrinths on the left, and ataxia and staggering to the left. The initial clinical impression was acoustic neuroma.

Roentgenograms showed the pineal shifted posteriorly 1.0 cm. and not displaced in the vertical plane. It was shifted slightly, also, to the right in the anteroposterior view. Because of the pineal shift, the films were interpreted as indicating a lesion on the left side of the brain and anterior to the pineal. In view of the symptoms of frontal tumor, with later development of diplopia, the clinicians agreed with the roentgenologist that a frontal tumor was a more likely possibility (Fig. 1).

A ventriculogram showed marked dilatation of the lateral and third ventricles and aqueduct, the aqueduct being displaced to the right and upward. No air was seen in the fourth ventricle.

Suboccipital exploration revealed beneath the left cerebellar hemisphere a very large, glistening, smooth, encapsulated tumor, filled with white cheesy material. The tumor, most of which was excised, extended up to the tentorium, medially toward the brain stem, and at its lower pole toward the 10th and 11th nerves.

Pathological Report: Epidermoid cyst: cholesteatoma.

Comment: In this case there was misinterpretation of the location of the tumor because of the type of pineal displacement. Instead of being anterior to the pineal, the tumor was discovered to be in the posterior fossa, both by ventriculography and by operation. A similarly mistaken interpretation of the pineal shift was described by Sosman (4) in a case in which the tumor blocked the aqueduct of Sylvius.

CASE 2 (U-247284): Acoustic neuroma. A 50-year-old housewife had been subject to increasingly severe right-sided headaches for two years, and

for one year had suffered from deafness, tinnitus, and ataxia. There had been daily vomiting just prior to admission.

Examination showed bilateral papilledema with enlarged blind spots, difficulty in upward and outward gaze, nystagmus, and hyperesthesia of the right face and scalp. There were complete deafness of the right ear and absence of labyrinthine function. The jaw deviated to the right and there were fibrillary twitchings of the tongue with cerebellar speech. There were also right-sided ataxia and a right Babinski sign.

Roentgenograms showed destruction of the posterior clinoids. The pineal shadow was shifted posteriorly 0.4 cm. but was not shifted in either the vertical or lateral plane. A ventriculogram demonstrated dilated lateral and third ventricles with slight displacement of the aqueduct to the left and upward.

Operation revealed at a depth of 4 or 5 cm. beneath the right cerebellum a tumor having the gross appearance of an acoustic neuroma. A biopsy was taken, but further operation was not attempted because of the vascularity and extent of the tumor and the condition of the patient.

Pathological Report: Neurofibroma.

Comment: The clinical signs and symptoms in the foregoing case pointed to a cerebellopontine angle tumor. Roentgenograms of the skull showed, besides pressure on the clinoids, a posterior displacement of the pineal which was not understood at the time at which the films were made. Ventriculography demonstrated internal hydrocephalus with displacement of the aqueduct.

Fig. 1. Lateral view of skull, Case 1, showing the posterior displacement of the calcified pineal gland (solid circle) from the usual position (broken circle).

CASE 3 (U-320346): Acoustic neuroma. A 31-year-old Italian carpenter had noticed, for five months before admission, blurring of vision in the right eye followed by severe headache and frequent morning nausea and vomiting. For two months he had been ataxic. Examination showed signs

pointing to a right cerebellopontine angle tumor with complete deafness on the right side.

Roentgenograms demonstrated erosion of the apex of the right petrous ridge in the region of the internal auditory meatus. The pineal was shifted 0.2–0.3 cm. posteriorly and 0.2 cm to the left. Encephalography was not done.

At operation, needle puncture showed the pressure in the right lateral ventricle to be increased. Beneath the right cerebellar hemisphere was a firmly encapsulated, reddish tumor running from the inferior surface of the tentorium to below the point of exit of the 9th to 11th nerves. The greater part of the mass was removed, leaving only a small amount which lay close to the internal auditory meatus and against the brain stem.

Pathological Report: Neurofibroma.

Comment: In this case, as in Case 2, operation confirmed the diagnosis of acoustic neuroma. Roentgenograms showed displacement of the pineal, which is not common in this type of tumor. *Posterior displacement* has not been described in any of the reported cases of acoustic neuroma which we were able to find.

DISCUSSION

Review of the reported subtentorial (posterior fossa) tumors shows that in the majority the pineal gland, if visualized, was not displaced. Unfortunately in many instances the position of the gland is not mentioned. Posterior displacement of the pineal, as described in the foregoing cases, is reported by three authors only: Dyke (1), 1930, in a case of cerebellar glioma; Sosman (4), 1936, in association with "a small tumor blocking the aqueduct of Sylvius"; Fray (3), 1938, in a cerebellar lesion; Dyke and Davidoff (2), 1940, in two cases of hemangioblastoma of the cerebellum.

The most frequent shift of the pineal described in the literature has been a slight upward displacement. Vastine and Kinney (6) reported upward displacement in 12 out of 43 cases; this occurred in none of our cases. A lateral shift has been less frequently described; 2 of our 3 cases showed a slight lateral shift.

The explanation of a posterior shift, which at first appears paradoxical, is suggested by the ventriculogram. In Cases 1 and 2, the ventriculogram showed dilated lateral and third ventricles with no filling of the fourth ventricle. In Case 3, ventricular puncture showed increased pressure and enlargement of the right lateral ventricle. Dyke's 3 cases (1, 2) showed internal hydrocephalus with rostral movement of the aqueduct and angulation of the aqueduct upon itself. Fray believed that the dilated third ventricle demonstrated in his case (3) pushed the pineal backward, and we agree with this explanation.

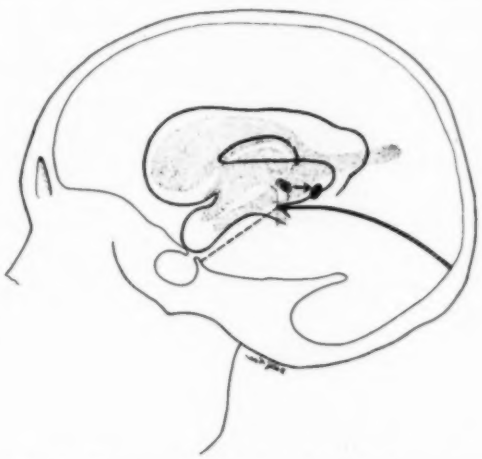

Fig. 2. Diagram of lateral view of ventricular system showing the probable cause of posterior displacement. In gray, the normal ventricular system: in outline, the larger system with internal hydrocephalus.

If obstruction occurs in the aqueduct, the third ventricle enlarges in all diameters; the floor is depressed so that it no longer is separated from the posterior clinoids by several millimeters of cerebrospinal fluid, but instead touches the clinoids. Erosion of the clinoids may result. Less frequently the posterior border of the ventricle is depressed and pushed backward. Twining (5) discussed these changes in detail. A posterior shift of the posterior wall of the third ventricle would result in displacement of the pineal backward, as was seen in the roentgenograms described above. It is unfortunate that we have no postoperative films in Case 3 to prove that with relief of the hydrocephalus the pineal might shift back to its normal position.

The posterior displacement may be looked for early as well as late. Our first patient had had symptoms for three years, the second for two years, and the third for only five months.

SUMMARY

Three cases are presented of proved subtentorial brain tumors, in which the lateral skull roentgenograms showed a *posterior* shift of the calcified pineal. The roentgenologist should bear in mind the possibility of this apparently paradoxical movement of the pineal, which may be due to internal hydrocephalus caused by obstruction to the outflow of spinal fluid through the aqueduct.

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A Stereoscopic Method for the Localization of Intraorbital Foreign Bodies[1, 5]

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THE RADIOGRAPHIC methods now in use for the localization of intraorbital foreign bodies are satisfactory in the hands of experts, but rather complicated and difficult for those radiologists who are called upon to use them on rare occasions. The object of this paper is to present a simple method in which the position of intraorbital foreign bodies is easily determined by the direct observation of stereoscopic films. Pancoast, Pendergrass, and Schaeffer have stated, "If the globe were of sufficient contrast to be differentiated in the roentgenogram from the surrounding structures, the localization would be a relatively accurate and simple procedure." In this method, by artificial means, we have supplied the necessary bulbar contrast on a stereoscopic pair of x-ray films.

Our method requires the use of a localizer and of a roentgen-visible artificial eye. The localizer (Fig. 1, A) consists of a heavy triangular base supporting a vertical mast. This mast carries a horizontal pointer which can be fixed at any level and can also be moved forward and backward by means of a screw. The base, vertical mast, and horizontal pointer are so constructed that when the pointer is locked in place by the set screw, it is always at right angles to the posterior border of the base. The base fits snugly against the rim of the radiographic table, and as a result the pointer is parallel to the center line of the table top. The end of the pointer is perforated along its axis and in this hole one can insert the metal stem which carries the artificial eye. The depth of the hole is such that the corneal surface of the artificial eye will always be 1 mm. from the tip of the horizontal pointer.

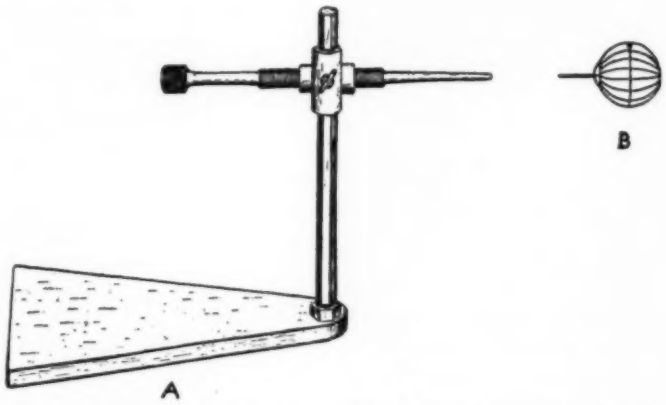

Fig. 1. The instrument. A later model has an x-ray opaque lens within the eyeball.

The artificial eye (Fig. 1, B) is a wooden ball accurately shaped to the average

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[4] Chief of E.E.N.T. Service, LaGarde General Hospital.

[5] Approved by War Department Manuscript Board, Oct. 16, 1942.

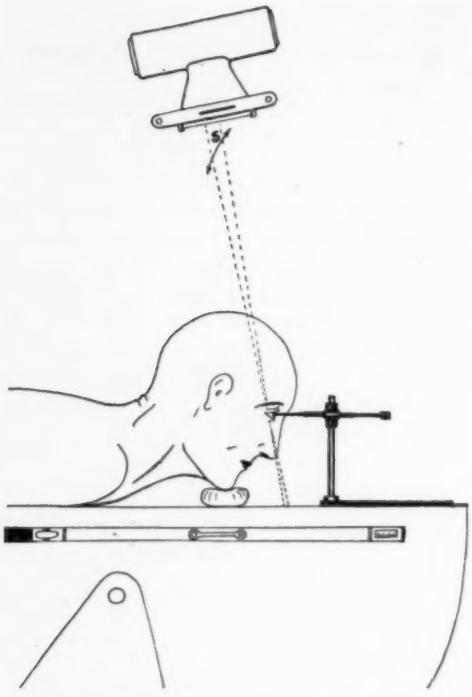

Fig. 2. Patient positioned for exposures.

dimensions of a normal adult human eye. Thin metal wires acting as radiopaque markers are placed on this ball along the corneo-scleral junction, along twelve meridians, and along the equator. A radiopaque lens attached to the metal stem and constructed to proper dimensions is placed within the wooden ball in the exact position of the lens of the human eye. The metal stem protrudes from the center of the corneal surface along the axis of the artificial eye.

The localizer and artificial eye can be easily constructed by any machine shop which possesses an accurate lathe. Our instrument was built to specification in the Orthopedic Shop at LaGarde General Hospital. Labor is the important item of expense, as the cost of materials is negligible. It is believed the instrument could be constructed rather cheaply in comparison with the cost of other apparatus now obtainable.

The patient is asked to lie prone on a Bucky table. He is then placed in the center of the table parallel with the long axis. The chin is slightly raised by a small cotton pillow and the head immobilized. The patient should look straight forward with his good eye and focus on a designated point which is at the same height as the uninjured eye, and in line with the long axis of the table (Fig. 2).

The localizer is now set so that the pointer is along the visual axis of the injured eye, with the end of the pointer 1 mm. from the center of the cornea (Fig. 3, I). This is easily accomplished, since the instrument is so constructed that, when it is placed in position, the pointer will always be parallel to the axis of vision in the uninjured eye. Horizontal movement of the entire localizer and vertical movement of the pointer allow easy centering to the axis of vision of the injured eye. The pointer is then screwed forward until the tip is 1 mm. from the center of the cornea.

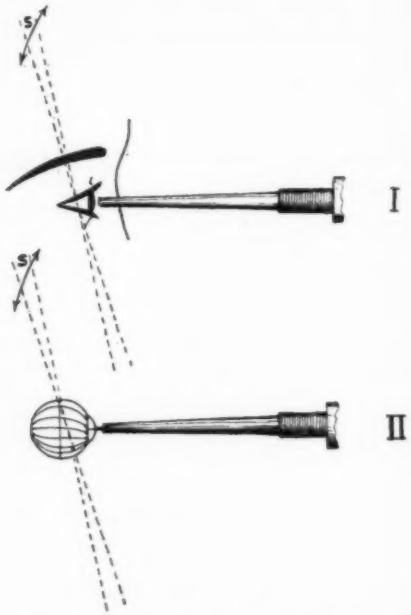

Fig. 3. Instrument in position for: (I) original exposure of patient; (II) flash exposure of the artificial eye.

A cassette is placed in the Bucky so that one edge abuts against the edge of the tray and the cassette is centered under the eye. The tube carriage is inclined 10 degrees cephalad, and the tube is centered to the table top and the cassette. The tube is then moved to one end of the stereoscopic shift and an exposure is made. Average factors used for this exposure with our equipment are 55 kv., 30 ma., 30-inch distance, 1 mm. Al filter, Bucky, 3 seconds with Eastman mid-speed screens. The cassette is now removed and set aside after marking the edge which was against the edge of the tray. The stereoscopic shift is in the transverse direction and a 3-inch total shift is used. The tube is now moved to the other end of the stereoscopic shift, another cassette is inserted in the Bucky, and another exposure is made. Without moving the tube, the localizer, or the second cassette, the patient is asked to slide away from the pointer and get off the table. After the patient is off the table, the stem of the artificial eye is inserted in the end of the pointer (Fig. 3, II) thus placing the artificial eye in the position occupied by the injured eye, and the film is re-exposed with an amount of x-ray sufficient to cast a very light shadow of the artificial eye upon the previous roentgenogram of the orbit. The average factors are 28 kv., 5 ma., 30-inch distance, 1 mm. Al filter, Bucky, 1 second with Eastman mid-speed screens. This cassette is now removed and the first cassette is again placed on the Bucky tray in the same position that it occupied during the first exposure of the orbit. After moving the tube to the first position of the stereoscopic shift, another exposure, with the low-voltage technic given above, is made, thus casting the shadow of the artificial eye on the first film of the orbit.

As a result of these manipulations, one obtains a pair of stereoscopic films of the orbit and of the foreign body on which will also be cast the stereoscopic shadows of the artificial eye (Fig. 4). After proper processing, these films are placed in the stereoscope and the position of the foreign body is determined by direct visual observation. We have found, by experience, that any error in placing the films for the first and second exposure will result in a blurring or double image of the pointer, and these films must be discarded. This serves as a check for proper technic. "No-screen" films have been recommended for the localization of foreign bodies because imperfections or particles of dust over intensifying screens may simulate foreign bodies within the tissues examined. We have used regular cassettes with intensifying screens and have not encountered this difficulty because our films were taken stereoscopically. Obviously, any shadow due to dust or imperfection of one cassette will not disturb the stereoscopic image of both films.

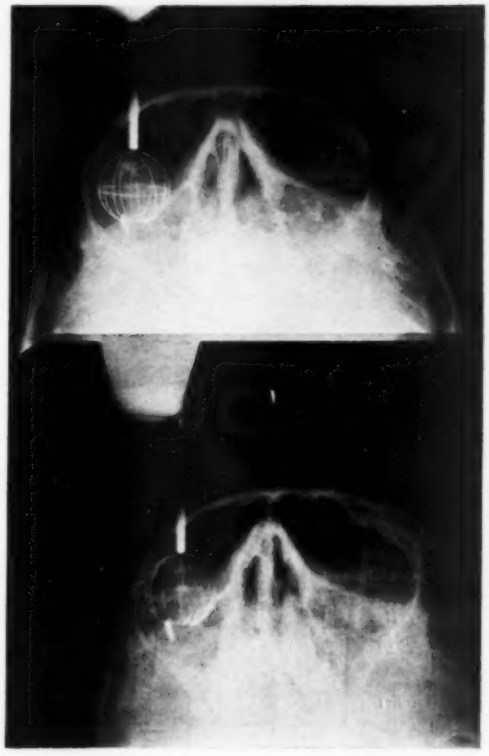

Fig. 4. Complete stereoscopic radiographs.

This method, like the Sweet method, utilizes average adult ocular dimensions to establish the position of foreign bodies.

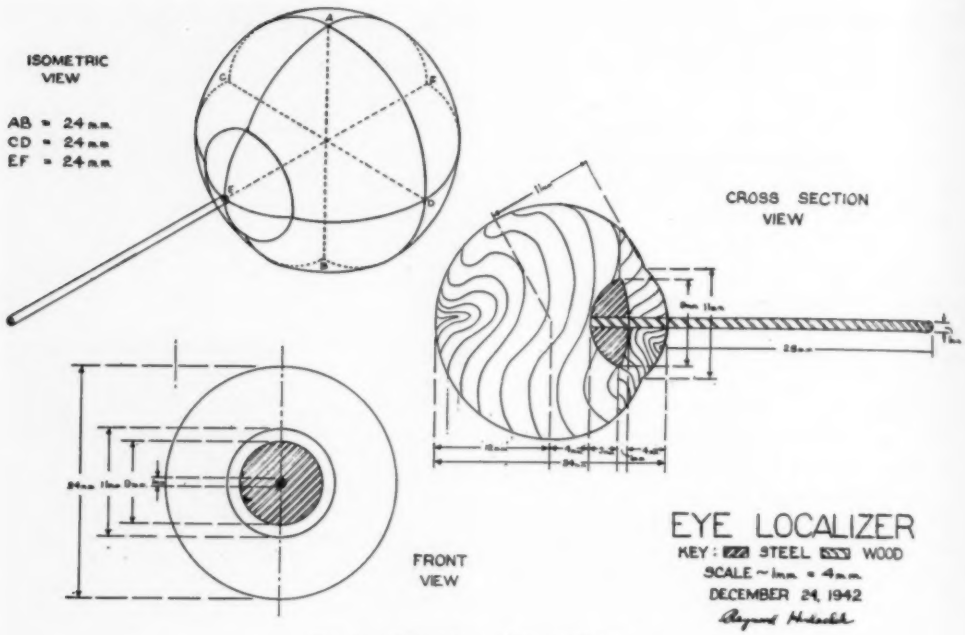

Fig. 5. Dimensions of the artificial eye.

Since average ocular dimensions vary only slightly, the method can usually be considered accurate, but caution should be exercised in children and in those conditions which are known to cause changes of the axial length of the eye, especially when a foreign body appears close to the posterior periphery of the shadow of the artificial eyeball.

We use the following system in reporting the location of foreign bodies within the eye. If their location is near the lens, the position is given as of the o'clock meridian and its proximity to the lens. If the foreign body is within the anterior or posterior chamber of the eye, its location is given in the same way, with the addition of the position in reference to the cornea. If the foreign body is behind the lens, it is located in reference to the o'clock meridian, the vertical equatorial plane, and the horizontal plane. Thus, the foreign body is located within a one-eighth segment of a sphere, and additional information is given as to how near the periphery it lies.

An added advantage from the standpoint of the ophthalmologist is that he may actually visualize the foreign body within the eyeball. Thus, by the aid of a visual image in addition to a location by measurement from certain known points, the ophthalmologist can more accurately determine the correct type of surgical approach.

Attention is invited to the fact that to utilize the method, a primary requisite is the possession of good stereoscopic vision by the roentgenologist and the ophthalmologist.

In our hands, this method has proved satisfactory and in some cases the localization has been superior to other methods. It has been presented in the hope that, following use by other men in a large number of cases, its accuracy and usefulness in comparison to established procedures can be determined.

LaGarde General Hospital
New Orleans, La.

REFERENCE

PANCOAST, H. K., PENDERGRASS, E. P., and SCHAEFFER, J. P.: The Head and Neck in Roentgen Diagnosis. Charles C Thomas, 1940, pp. 503–536.

A Study of Roentgen-Ray Distribution at 60–140 Kv.P.[1]

Z. I. ATLEE and E. D. TROUT

Chicago, Ill.

STUDIES OF THE distribution of radiation about an x-ray tube are not new. Kaye (1) wrote about it in 1909. Coolidge and Kearsley (2) reported on it in 1922, and Bouwers (3) discussed it in 1928. More recently its significance and practical application have been reported by Ginsberg and Landauer (4).

The subject has an important application in superficial therapy, where common practice calls for the use of large fields at a short focal skin distance. The distribution problem is especially important because the use of shock-proof tubes and equipment has made it more difficult to change from one type of tube to another. With non-shock-proof tubes it was a simple matter to remove the diagnostic tube from the lead glass bowl and substitute the therapy tube.

A study of distribution and field coverage may have a useful application in the planning of protection and the design of equipment, especially in fluoroscopy. Also, to a lesser degree, it may be of value in diagnostic applications, although the distances used for radiography are usually so great as to make use of only a small part of the total field.

The purpose of this discussion is to report the results of experiments to study the influence of several factors on the distribution of radiation in what is usually considered the useful part of the field. The investigation covered the voltage range between 60 kv.p. and 140 kv.p., with most of the work carried out at 100 kv.p., since it was felt that the results would have widest application in the field of superficial therapy.

The study reported here deals only with those voltages used in superficial therapy and has no direct association with the more theoretical study of spatial distribution.

METHOD OF MEASUREMENT

The high-voltage source for all the work was of the half-wave type, either self-rectified or a two-tube rectifier. The results with both circuits were identical, and there is no evidence that full-wave rectification would have altered them. All measurements were made using an x-ray tube current of 5 ma.

A Victoreen condenser r-meter was used throughout the investigation. All measurements were made at the same focal chamber distance. To provide this constant focal chamber distance, a steel bar was formed to a radius of 50 cm. The arc was calibrated in degrees, and by means of a clamp and indexing pointer the chamber could be positioned accurately to any point on the arc. Readings of the intensity of the radiation were made on this arc both parallel and perpendicular to the tube axis.

The chamber was first centered directly below the focal spot. The intensity at this point was taken as 100 per cent and is referred to as the "central beam." The intensity at other points was plotted as the percentage of this central beam. At 60 kv.p. and 100 kv.p. studies of filtered radiation were made, using 2 mm. Al. At 140 kv.p. the filtered studies were made using 0.25 mm. Cu and 1.0 mm. Al.

UNIVERSAL TYPE COOLIDGE TUBE

Many of the methods used in the practice of superficial therapy have been established around the Universal type Coolidge tube. It seemed advisable, therefore, to study the distribution about a tube of that type before proceeding to the more modern types. From a consideration of geometry the Universal tube should provide a good

[1] Presented before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

distribution pattern. The 45° target angle of the anode and the spherically shaped bulb are nearly ideal for obtaining uniform distribution throughout a large field. The main difficulties with this type of tube have been due to non-uniformity of the envelope and target pitting. Variations in wall thickness of 100 per cent over the useful part of the bulb could be expected.

For the experiments a hard glass Universal medium-focus tube was used, especially selected for uniformity of bulb thickness and with an unpitted focal spot.

The distribution patterns at 100 kv.p.

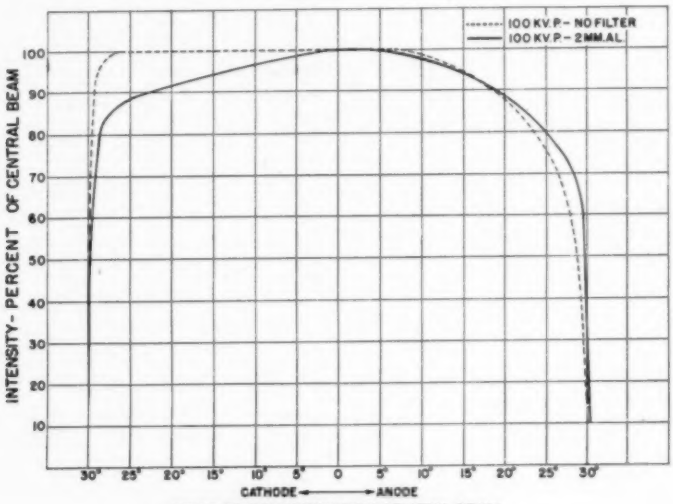

FIG. 1. UNIVERSAL TYPE COOLIDGE TUBE—INTENSITY PARALLEL TO TUBE AXIS

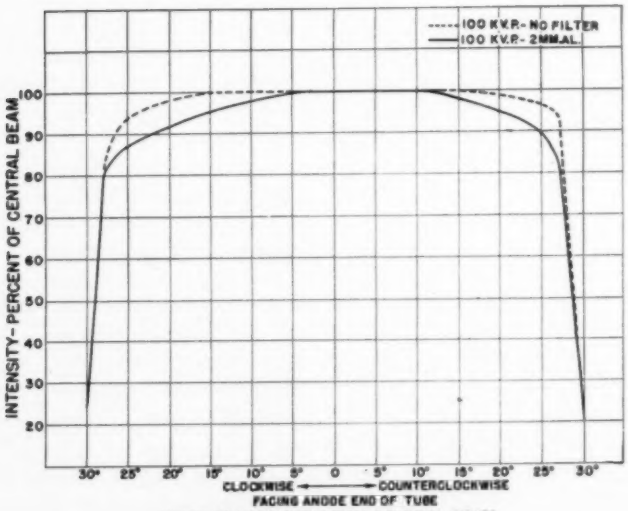

FIG. 2. UNIVERSAL TYPE COOLIDGE TUBE-INTENSITY PERPENDICULAR TO TUBE AXIS

are shown in Figures 1 and 2; at 140 kv.p., in Figures 3 and 4.

In the case of unfiltered radiation parallel to the tube axis, the first characteristic noted is the rapid falling off of the radiation toward the anode end of the tube. This undoubtedly is due to the fact that the radiation is not produced at the finite surface of the target. The electrons penetrate well past the first atomic layers before a collision occurs with a tungsten atom, giving rise to the x-radiation. The radiation thus produced below the surface layer is filtered by the tungsten itself with re-

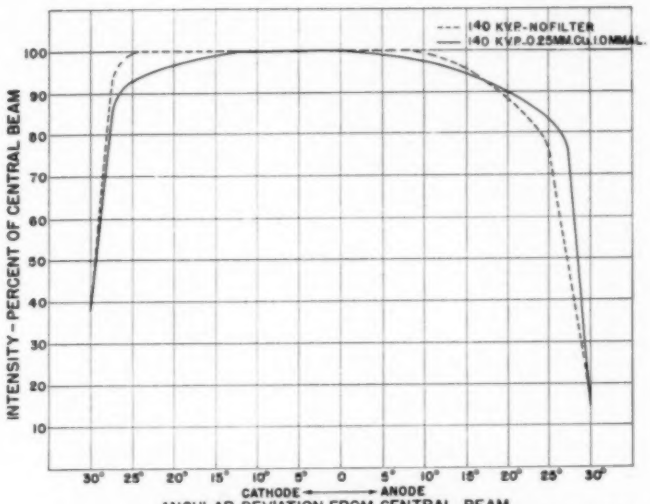

FIG. 3. UNIVERSAL TYPE COOLIDGE TUBE-INTENSITY PARALLEL TO TUBE AXIS

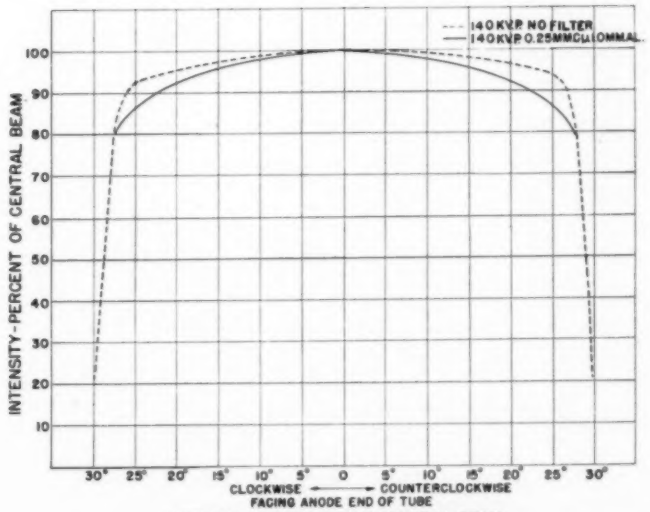

FIG. 4. UNIVERSAL TYPE COOLIDGE TUBE-INTENSITY PERPENDICULAR TO TUBE AXIS

sulting loss in intensity before it emerges from the target. Obviously, the thickness of the tungsten that must be penetrated is reached where the cathode intercepts the beam.

When a filter is added, the decrease in

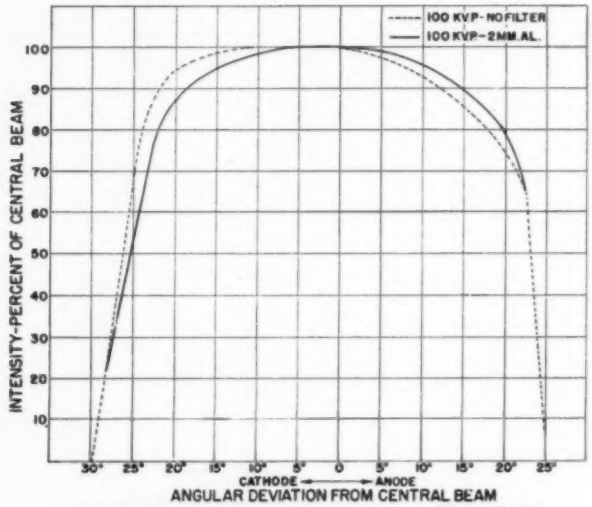

FIG. 5. OIL-IMMERSED SUPERFICIAL AND MEDIUM THERAPY TUBE— INTENSITY PARALLEL TO TUBE AXIS

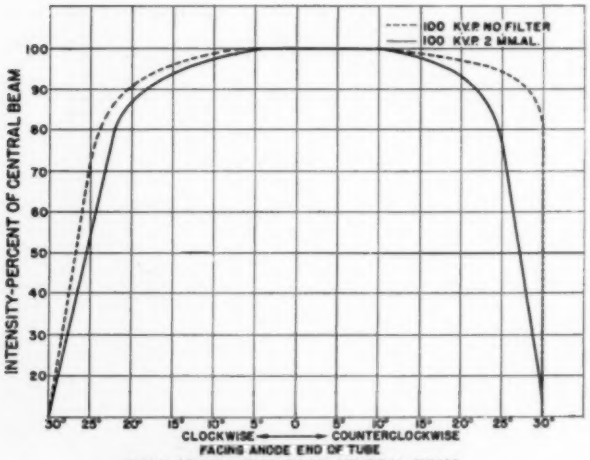

FIG. 6. OIL-IMMERSED SUPERFICIAL AND MEDIUM THERAPY TUBE— INTENSITY PERPENDICULAR TO TUBE AXIS

creases toward the heel of the target or anode end of the tube.

With the Universal tube the intensity is uniform from the central beam toward the cathode end of the tube until a point intensity is not so abrupt toward the anode end of the tube. This is accounted for by the fact that the radiation emerging from a depth in the target becomes a progressively harder beam toward the anode and the filter

does not absorb so much of the radiation.

When filtration is added, the intensity toward the cathode end decreases in a manner that destroys the uniform pattern obtained without filter. This is accounted for by the fact that the filter thickness increases as the chamber is moved away from the central beam. At 10° the filter thickness has increased 1.5 per cent; at 15°, it has increased 3.5 per cent; at 20° 6.4 per cent.

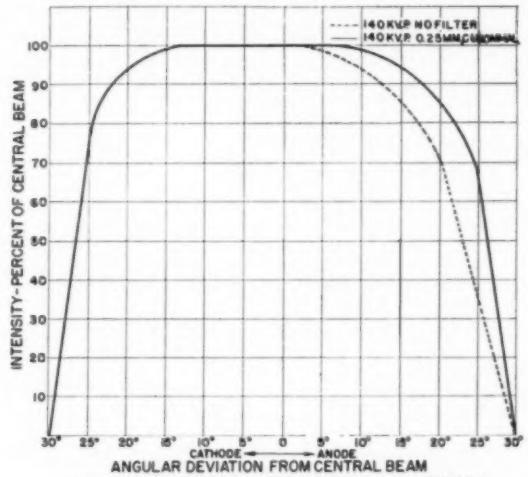

FIG. 7. OIL-IMMERSED SUPERFICIAL AND MEDIUM THERAPY TUBE—INTENSITY PARALLEL TO TUBE AXIS

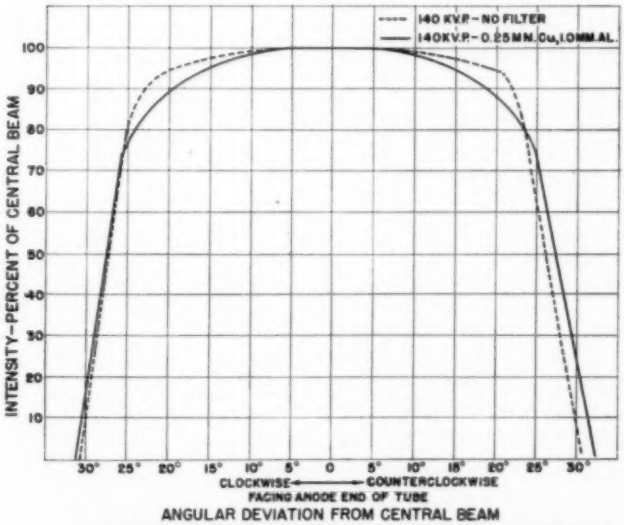

FIG. 8. OIL IMMERSED SUPERFICIAL AND MEDIUM THERAPY TUBE—INTENSITY PERPENDICULAR TO TUBE AXIS

At first glance there is a tendency to neglect this factor but, with a 2-mm. Al filter, the filter thickness at 20° is 2.13 mm. The additional 0.13 mm. of Al has an appreciable effect on a beam where

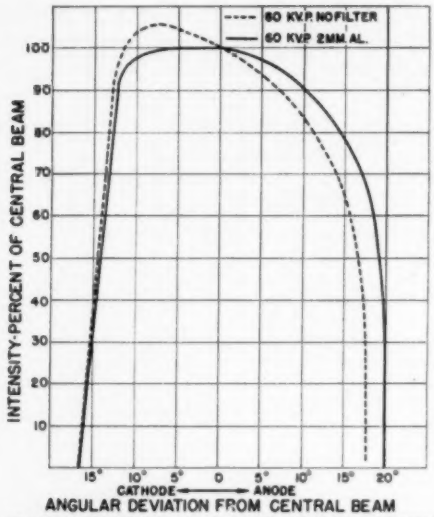

FIG. 9. 20° TARGET OIL-IMMERSED RADIOGRAPHIC TYPE TUBE—
INTENSITY PARALLEL TO TUBE AXIS

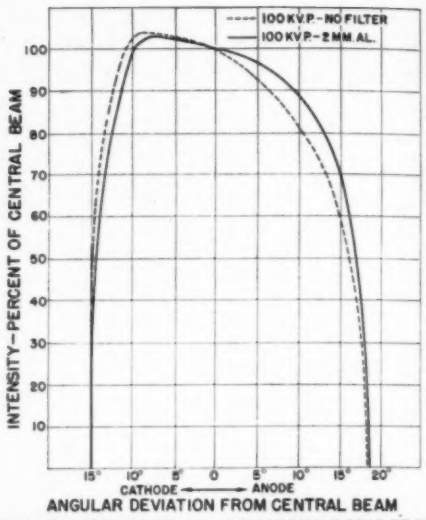

FIG. 10. 20° TARGET OIL-IMMERSED RADIOGRAPHIC TYPE TUBE—
INTENSITY PARALLEL TO TUBE AXIS

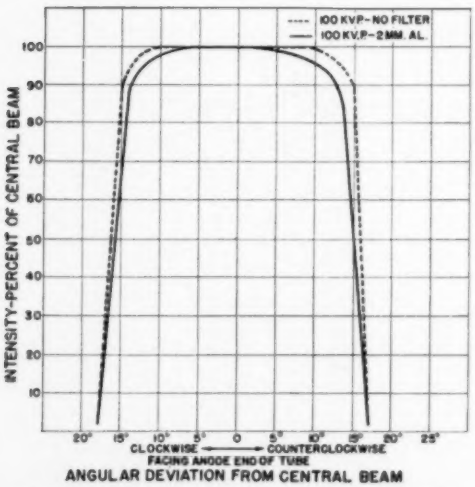

FIG. 11. 20° TARGET OIL-IMMERSED RADIOGRAPHIC TYPE TUBE—
INTENSITY PERPENDICULAR TO TUBE AXIS

the half-value layer is only 0.5 mm. Al.

In the axis parallel to the tube there is little difference between the unfiltered radiation patterns at 100 and 140 kv.p. In the case of filtered radiation there is a slight tendency for the field to spread and the pattern to become more uniform.

In the arc perpendicular to the tube axis the pattern is quite uniform in both directions from the central beam. The field is much more uniform than that parallel to the tube axis. The field is somewhat wider at the lower voltage. The addition of filter again narrows the field.

OIL-IMMERSED SUPERFICIAL AND MEDIUM THERAPY TUBE

The second tube studied was an oil-immersed tube intended exclusively for use in superficial and medium therapy. This tube has a copper anode with an inserted tungsten target at an angle of 30°. The bulb is of pyrex glass with a window ground to a uniform minimum thickness, consistent with operation at 140 kv. The x-ray distribution patterns for this tube, as obtained in the shock-proof housing in which it is used, are shown in Figures 5, 6, 7, and 8.

In an arc parallel to the tube axis the field is not so large as that obtained with the Universal tube but the uniformity of field at the cathode and anode ends is much better. The effect of the filtration of the target is again apparent. Since the anode angle is 15° less than for the Universal tube, the absorption toward the anode

end is further exaggerated. The effect of adding filter is again evidenced by a widening of the field toward the anode end of the tube.

In the arc perpendicular to the tube the distribution obtained compares favorably with that of the Universal tube, but the field of coverage is not so large.

20° TARGET OIL-IMMERSED RADIOGRAPHIC TYPE TUBE

The third tube studied was a 20° oil-immersed radiographic tube. Experiments at 60 and 100 kv.p. in the arc parallel to the tube axis (Figs. 9 and 10) indicate (Fig. 11) the intensity is quite uniform but the useful field is very small. Filtration again narrows the field.

Effects of Target Roughening: The two factors contributing most to the unsatisfactory intensity patterns provided by this tube are the acute anode angle and the rough surface of the focal spot. A study of Figure 12 makes these points clear. The small anode angle increases the path through the target, for that radiation produced at a depth in the target.

The focal spot of a radiographic tube is quickly roughened by radiographic loads, which raise the tungsten at the focal spot

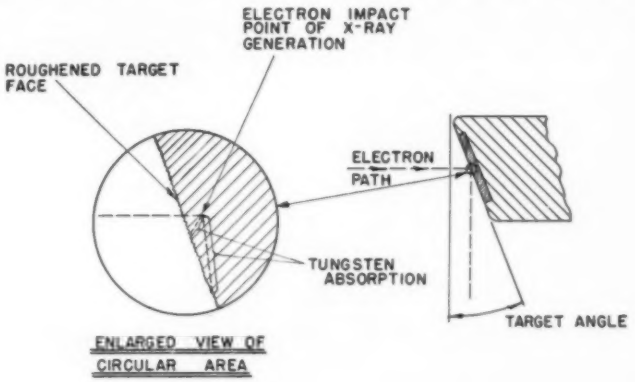

FIG. 12. GRAPHIC ILLUSTRATION OF VARIATION IN ABSORPTION IN A REFLECTION TARGET USED AT A SMALL TARGET ANGLE.

that the conditions that influenced the radiation pattern in the previous types studied are more pronounced in this type of tube. The target angle is so small that the point of maximum intensity is not in the geometric center of the field. For the unfiltered radiation the point of maximum intensity is approximately $7^1/_2°$ toward the cathode. The field coverage is very narrow, being somewhat greater at the lower voltage. The addition of filter shifts the field toward the anode end of the tube and brings the point of maximum intensity nearer to the central beam.

In an arc perpendicular to the tube axis above the recrystallization temperature, resulting in an etched area on the target. Any etching or roughening of the target is reflected in the radiation pattern; even though the tiny craters in the target may be barely visible to the eye, their depth is great when measured in electron diameters. Any exposure or abuse that causes the target to be etched or roughened will change the radiation pattern. The ratings of a therapy tube should be such as to prevent this condition.

To demonstrate this effect, a 20° oil-immersed radiographic tube was studied before being given its initial high-current

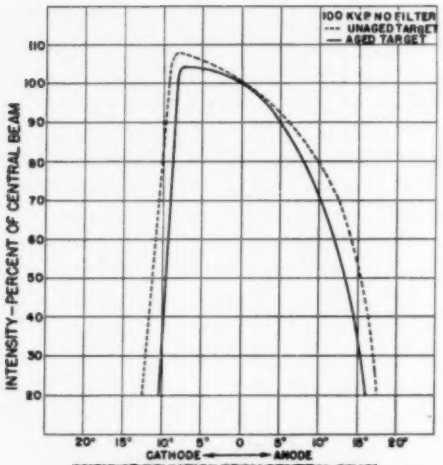

FIG. 13. 20° TARGET OIL IMMERSED RADIOGRAPHIC TYPE TUBE— INTENSITY PARALLEL TO TUBE AXIS

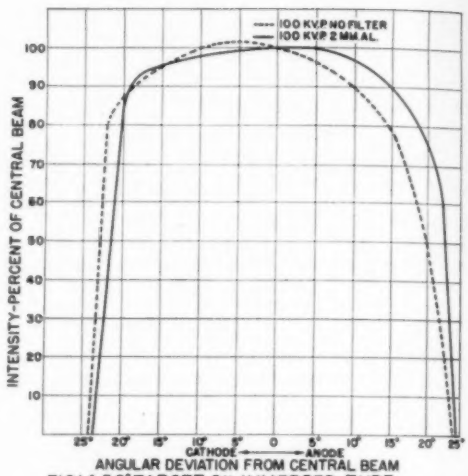

FIG. 14. 30° TARGET OIL-IMMERSED TUBE INTENSITY PARALLEL TO TUBE AXIS

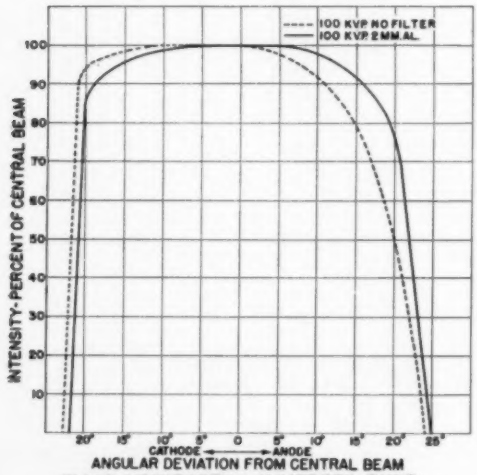

FIG. 15. 45° TARGET OIL-IMMERSED TUBE INTENSITY PARALLEL TO TUBE AXIS

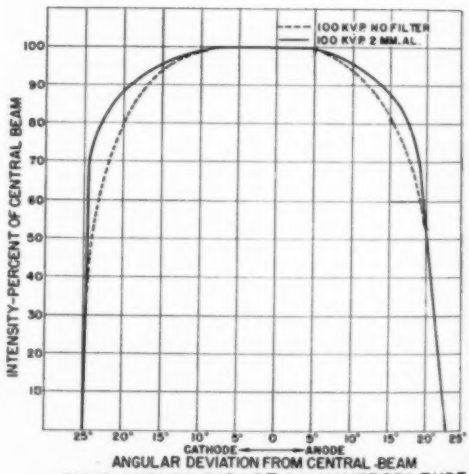

FIG. 16. CURVED TARGET OIL-IMMERSED TUBE INTENSITY PARALLEL TO TUBE AXIS

exposure. It was then given ten exposures at average radiographic loadings. The results are plotted in Figure 13.

A further study of the effect of a rough focal spot was made by taking a tube of this type and subjecting it to several thousand average radiographic exposures. The results are shown in Table I.

From these results it is evident that a tube used for radiography is not a satisfactory source of radiation for therapy where wide field coverage is desirable.

30° TARGET OIL-IMMERSED TUBE

To study the influence of the target angle without any change in tube housing or window structure, a 30° target tube was made and inserted into the same housing as was used for the 20° target. The results are plotted in Figure 14. The radiation pattern is a definite improvement over that obtained with a 20° target.

45° TARGET OIL-IMMERSED TUBE

To study further the effect of the target angle, a 45° target tube was made and inserted into the same housing. Figure 15 shows the result. The spread of the field is not improved over the 30° target but the point of maximum intensity has been brought back to the central beam and the pattern is more uniform.

TABLE I: CHANGE OF DISTRIBUTION WITH USE OF TUBE FOR RADIOGRAPHY
DX Tube (20° Anode)

Exposures	Angular Deviation from Central Beam Cathode←→Anode						
	15°	10°	5°	0°	5°	10°	15°
0	26%	107%	105%	100%	90%	78%	56%
7,000	..	40	103	100	89	74	41
10,000	..	50	103	100	91	75	41
12,000	..	54	108	100	91	78	38
16,000	..	31	103	100	90	75	44

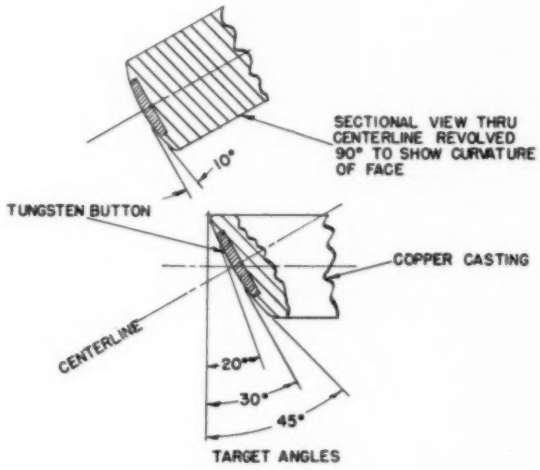

FIG. 17. CONVEX TARGET OIL IMMERSED SUPERFICIAL AND MEDIUM THERAPY TUBE.

CURVED TARGET OIL-IMMERSED TUBE

After studying the data obtained with the 20°, the 30°, and the 45° targets, it was thought that the best pattern in the arc parallel to the tube axis would be obtained in a tube where the angle of the target was gradually increasing toward the heel of the anode. In other words, a curved target.

Such a tube was constructed and inserted in the housing previously used, and data were taken. As will be seen from Figure 16, the field parallel to the tube axis is more uniform in both directions from the central beam than was obtained with any of the other tubes. The total field coverage was only slightly less than that obtained with the 45° target. Note that with the curved target the field coverage is greater when filter is added. Uniformity of pattern would seem to more than compensate for the slight loss in field size.

CONVEX TARGET OIL-IMMERSED TUBE

The results with the curved target led to the conclusion that the use of a target curved in both planes would provide an optimum pattern both parallel and perpendicular to the tube axis. The term "convex target" would seem best to describe a tube of this type, as shown in Figure 17.

Such a tube was constructed and the results appear in Figures 18 and 19. Of all the tubes studied, it gives the most uniform pattern consistent with a large field.

TECHNIC CONSIDERATIONS

From the foregoing data it should be possible to work out the best method to be used for the type of tube selected. The technic chosen must take into consideration the geometry of the field pattern at the point of application.

To facilitate the change from angular deviation from the central beam to the coverage field radius in centimeters, Table II has been prepared.

The data reported herein were plotted as a function of the angular deviation from the central beam on an arc. In actual use it may be desirable to consider the intensity in a plane rather than on an arc. To do this, the increasing distance from the focal

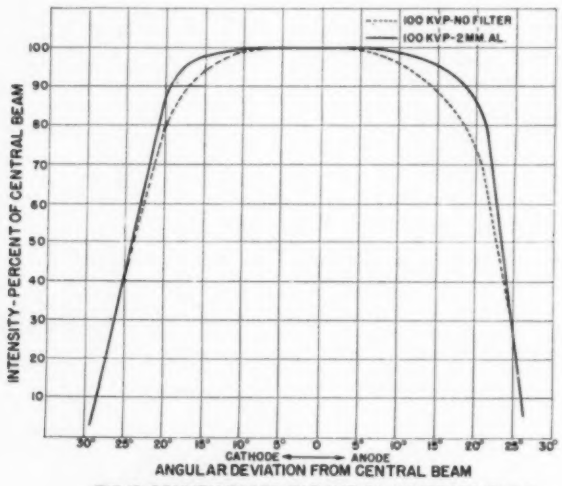

FIG. 18. CONVEX FACED TARGET OIL-IMMERSED TUBE
INTENSITY PARALLEL TO TUBE AXIS

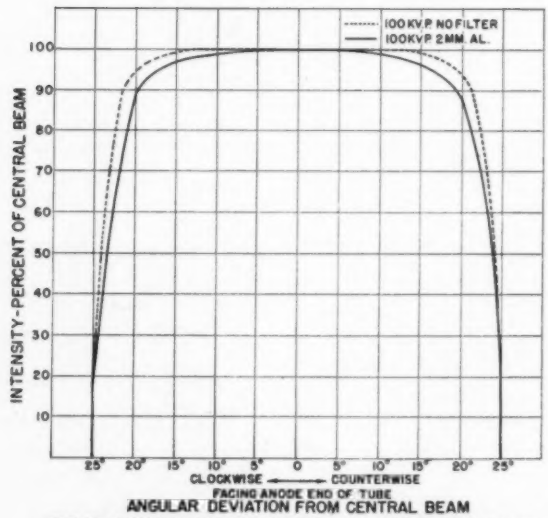

FIG. 19. CONVEX FACED TARGET OIL-IMMERSED TUBE
INTENSITY PERPENDICULAR TO TUBE AXIS

TABLE II: ANGULAR DEVIATION FROM CENTRAL BEAM VS. RADIUS OF FIELD

Angle	Focal Skin Distance 25 Cm. Field Radius	30 Cm. Field Radius	50 Cm. Field Radius
5°	2.2 cm.	2.6 cm.	4.4 cm.
10	4.4	5.3	8.8
15	6.7	8.1	13.4
20	9.1	11.0	18.2
25	11.7	14.0	23.3
30	14.4	17.3	28.8

spot as a point moves away from the central beam must be taken into consideration. This can be computed by use of the inverse square law. To make the application of this material easy, the factor by which the intensity on an arc must be multiplied to obtain the intensity on a plane is shown in Table III.

TABLE III: FACTOR BY WHICH INTENSITY MEASURED ON AN ARC MUST BE MULTIPLIED TO OBTAIN INTENSITY ON A PLANE

Radius of Field	Focal Plane Distance at Central Beam 25 Cm. Intensity at Edge of Field on a Plane	30 Cm.	50 Cm.
5 cm.	0.96	0.97	0.99
7	0.93	0.95	0.98
10	0.86	0.90	0.96
15	0.74	0.80	0.92
20	0.61	0.69	0.86
25	0.50	0.59	0.80
30	..	0.50	0.74

SUMMARY

1. Intensity of radiation on an arc parallel to the tube axis and perpendicular to the tube axis has been measured for the following common types of tubes:

(*a*) Universal type Coolidge tube
(*b*) Oil-immersed superficial and medium therapy tube
(*c*) 20° target oil-immersed radiographic type tube

2. The following experimental types were constructed and studied:

(*a*) 30° target oil-immersed tube
(*b*) 45° target oil-immersed tube
(*c*) Curved target oil-immersed tube
(*d*) Convex target oil-immersed tube.

3. Conventional types of x-ray tubes can be used for superficial therapy providing the limitation in uniformity of the field is taken into consideration.

4. X-ray tubes used for therapy should not be used for radiography, because of changes in the field intensity pattern due to target roughening.

5. The target angle of a tube designed for superficial therapy should be at least 30 degrees.

6. A curved or even a convex target face for a tube to be used only for superficial therapy makes possible an improvement in field distribution.

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DISCUSSION

K. Wilhelm Stenstrom, Ph.D. (Minneapolis Minn.): It seems to me that the measurements, that have been presented here are of considerable value and are worth our consideration.

It is well known to all of us that the radiation that we use in treating patients is not evenly distributed over the field, though usually we pay slight attention to this. As the variation may be considerable from one tube to another, from one machine to another, it may mean that when we give the same number of roentgens with two different machines, the patient is not really receiving the same dose. The dose we record is only that given to the center portion of the field.

In many cases the difference may not be great, but under certain circumstances it can be considerable and it is evident that, when machines are standardized, it is well to have the distribution over the field measured. Even with 400 kilovolts and 80 centimeter distance there is a noticeable difference between the radiation toward the anode end and toward the cathode end.

When the tube gets older, the distribution may be considerably changed, as the speaker has pointed out, *i.e.*, when the target gets rough.

It is evident that the difference in distribution over the field becomes very much greater when large

fields are used because we are using plane surfaces, so that the difference in the distance plays an important role. We have heard, for instance, about treatments given to the whole trunk at 50 centimeters. In such a case it is rather difficult to say what dose the body receives because in the center it receives quite a different dose from what it receives at the edges of the field.

Perhaps the most important part of this presentation is the advice that can be given for the use of types of tubes and for the improvement in construction of tubes.

There are two things I want to ask about. First, the measurement showed that intensity went down abruptly to practically zero at the edge of the field. I wonder if there isn't some radiation outside of the field. As a rule, we find considerable radiation outside the field.

The other question is: What type of distribution would result if the electrons were not focused at the top of the convex target? It would seem that when a tube is constructed, it may not be possible to get the electrons to hit right at the center; then the higher portion of the target would shield the x-rays. It seems to me that it might be better to have a flat surface surrounded by rounded edges rather than a convex surface.

Robert S. Landauer, Ph.D. (Highland Park, Ill.): I would like to give a word of warning in case any experimental work is attempted along this line. Mr. Trout has said that the fields are un-uniform and are small. Actually, if the ordinary twenty-degree target tube is used and the fields are at an 8 or 10 inch distance, the field sizes are of the order of 4 or 5 inches in diameter. That is all. One may be tempted to see how large the field is by using a fluoroscopic screen or by simply pointing the tube down at an intensifying screen in a cassette without a film, in other words, by some fluoroscopic method. This will give an entirely wrong picture, since the energies that are being used will so over-excite either a fluoroscopic or an intensifying screen that wherever there is radiation the result is a perfectly nice, beautifully lit-up screen which will give no indication of the actual variation of intensity. If any such measurements are made, it is necessary to make them with an ionization chamber.

I would like to ask Mr. Trout what effect he found on field sizes when he made more than ten radiographic exposures.

E. D. Trout (*Closing*): In answering Doctor Stenstrom's questions, I might say that where we showed the radiation falling off quite rapidly, we were using a 100-roentgen chamber in most of the work and whenever we dropped to an intensity of 10 per cent, we stopped there and ceased to be interested in it.

So far as the curved target was concerned, at the point at which the electron strikes the target, the focal spot, the target is practically flat and starts to curve at that point. We attempted to get that focal spot on the target at a point just before we started cutting away the heel of the anode.

Doctor Landauer's help has been great throughout all this work. I have talked with him several times about it and its practical application. I can reinforce his statement about the use of the fluoroscopic screen by saying that we came to the conclusion that one couldn't even use a film, for if a radiograph was made, the apparent field and actual useful field, when checked with ionization, were not comparable at all.

Doctor Landauer also asked about the effect on field sizes when more than ten radiographic exposures were made. In the paper as prepared for publication, there is a table [Table I] showing the change for every five thousand exposures through fifteen thousand exposures.

Increased Filtration for Diagnostic Purposes[1]

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Geisinger Memorial Hospital, Danville, Penna.

THE CUSTOMARY roentgenographic practice is to produce a film of high contrast by using a low voltage and little or no filtration. This produces a brilliant film, but may sacrifice diagnostic quality.

A radiograph is a combination of shapes and light values representing the shadow outlines and relative densities of the object being radiographed. Two essentials of good radiographs are affected by filtration: sharpness of outline and a suitable spread of light values between the lightest and darkest.

Sharpness of outline is necessary to identify properly the shape of the shadow of the object being studied. It is particularly important where slight variations in density produce only slight differences in light values on the film, since a hazy outline may allow such an indefinite transition between two values that the eye will be unable to detect the border line.

The relative densities of many parts of the body are similar. Difference of density introduced by disease may also be slight. For example, the density of the exudate in an early pulmonary tuberculosis may differ but little from that of the surrounding lung. The densities due to a bone tumor may vary only slightly from the surrounding muscle, fascia, and bone.

A radiograph of only two values, light and dark, would give us merely a silhouette. The introduction of a middle value would allow a small amount of information about the interior of the object being studied. The more intermediate values we introduce between the lightest and darkest, the greater the possibility of identifying the inner structure of the object.

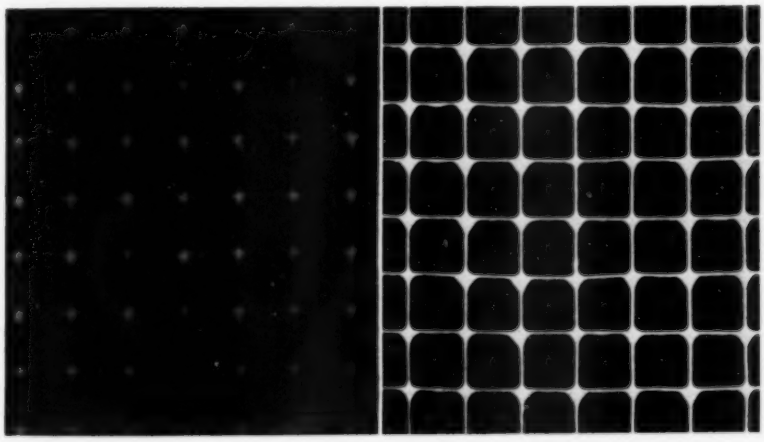

Fig. 1. Increase in sharpness of outline produced by increasing the filtration. The example on the left was made with no filter; that on the right with 3.0 mm. aluminum.

The introduction of filters into the beam of x-rays in the diagnostic range improves both the sharpness and the number of identifiable values. One millimeter of aluminum makes slight difference as compared with no filter. Increasing the filtration up to 3 or 4 mm. aluminum produces

[1] Presented before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

material improvement, which is only slightly enhanced by increasing to 6 mm. Beyond this latter figure there is no appreciable gain.

Filtration reduces the intensity of the whole beam, but particularly in the longer wave lengths. The first effect, an increase in sharpness of outline, is probably due to a decrease in the scattering which follows reduction in the proportion of long wave lengths. A slight increase in sharpness is obtained by introducing 1 mm. aluminum; a marked increase if 3 mm. aluminum are used. This difference is readily visible to the naked eye. There is only a slight further increase in sharpness with 6 mm. aluminum, not visible to the naked eye.

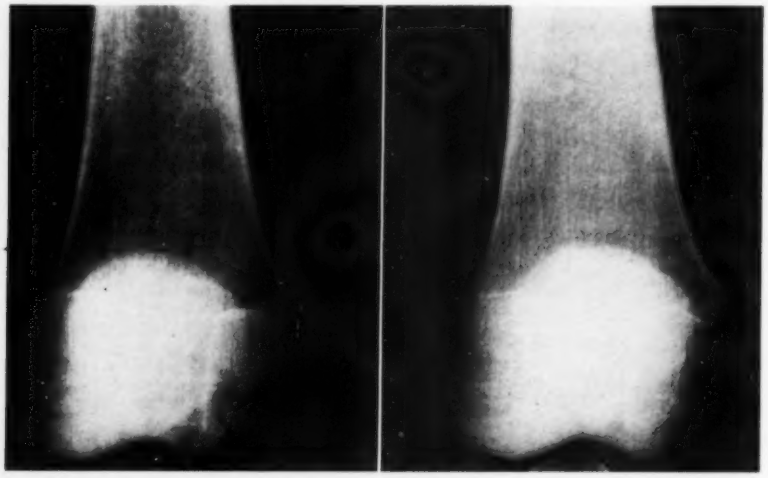

Fig. 2. Increase in sharpness as illustrated in the same section of bone. The example on the left was made with no filter; that on the right with 3.0 mm. aluminum.

Figure 1 illustrates the difference in sharpness obtained by the introduction of 3 mm. aluminum as compared with no filter. The original film does not show quite so great a difference. While every effort has been made to eliminate this exaggeration, it appears to be an inevitable accompaniment of the reproduction process. Figure 2 shows the difference as seen in two exposures of the same section of bone.

There is a small increase in the number of identifiable values on adding 1 mm. aluminum. Again, there is a definite increase when the filtration is raised to 3 mm. aluminum, and only a slight further increase with 6 mm. This improvement is particularly noticeable in the lightest and darkest steps. Figure 3 illustrates this with exposures of an aluminum ladder. In this example some of the small differences in the darker and lighter values are lost in the process of reproduction, so that actually the advantage of the increased filtration is greater than appears here. Figure 3 also illustrates the improvement in visibility of the various values because of increased sharpness.

With the lowest voltages used, between 40 and 50 kv., increasing the filtration does reduce the number of values. Therefore, with such low voltages no added filtration should be used. In studying thin parts, however, such as fingers and toes, a higher voltage with increased filtration gives a more informative radiograph. Due to the increased sharpness of outline and the greater number of values, it is possible to produce a good film of the soft parts and bone structure at the same time. This is illustrated in Figure 4.

The optimum increase in filtration seems to be in the neighborhood of 3 or 4 mm.

aluminum. Beyond this point the increase in sharpness and number of values is not important. No absolute values can be given for the optimum filtration, for the photographic effect depends upon the film characteristics, the use of intensifying screens, and the characteristics of the screens. It also depends upon the taste of the reader and his ability to distinguish small differences in value. The use of the advantage lies with the films made with a filtered beam, as a better balance between bone and soft tissue density is obtained.

Another place where increasing the filtration is advantageous is in those parts where there is a marked inequality of thickness, as in some thighs, or the chest in stout patients with large breasts. Due to the increased number of visible values, the entire

Fig. 3. Increase in visible values as demonstrated with an aluminum ladder. From left to right: No filter; 1.0 mm. aluminum; 3.0 mm. aluminum; 6.0 mm. aluminum.

3 mm. aluminum will cover most situations.

The advantages of increased filtration are apparent, whether or not intensifying screens are used, in films made with the Bucky diaphragm and in non-screen films. The increased sharpness is not so apparent in films of the hands and feet, where the objects to be rayed can be brought close to the film. Even in this situation, however, area will be more evenly illuminated, so that the thick as well as the thin portions will be of diagnostic significance (Fig. 5). Contrary to the first impression, increasing the filtration does not "burn out" small differences in value as does over-penetration.

Increasing the filtration from no filter to 1 mm. aluminum requires no change in technic. The addition of 3 mm. aluminum

Fig. 4. Soft tissue and bone detail seen on the same exposure made with 3.0 mm. aluminum filter.

requires about a 10 per cent increase in exposure, either by increasing the kilovoltage or the time. In the lower voltages, between 40 and 50 kv., better radiographs will be obtained by increasing the voltage 2 to 5 kv. Above 55 kv. good results will be obtained by increasing either voltage or time. Filtration of 6 mm. aluminum requires about a 25 per cent increase in exposure.

The films produced with increased filtration are not so beautiful as the more contrasty ones made with little or no filtration. The background will not be as opaque. The white values may not be as white, so that the over-all effect is less brilliant. The increased ability to make out fine details and identify structures ordinarily hard to see, such as the spinous processes in a lateral spine, will compensate, however, for the lost beauty of the more contrasty film.

In summary, increasing the filtration of the x-ray beam in diagnostic radiography with a commensurate increase in exposure is advocated, because it produces increased sharpness of the shadows and increases the range of values obtainable.

No claims for originality are made in this presentation. The idea was suggested by

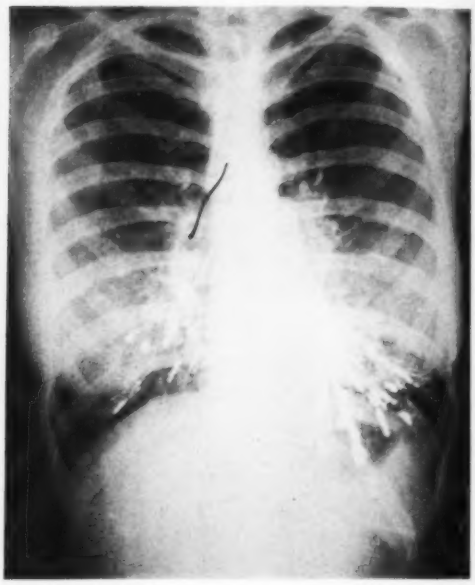

Fig. 5. Film made with 3.0 mm. aluminum filter. The whole area is well illuminated from the apex to the area below the diaphragm, with no loss of lung detail.

Allen and Calder in 1940. As their contribution appeared in the *British Journal of Radiology*, which is not seen by many radiologists in this country, this paper is presented to call attention to their suggestion, and to confirm, with some minor variations, their conclusions.

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Dosage Calculations for Various Combinations of Parametrial Needles and Intracervical Tandems[1]

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Memorial Hospital, New York

RADIUM APPLICATION by interstitial parametrial needles in combination with intracervical tandems has been used and advocated in recent years by several authors (3, 4, 5). The published clinical results are quite promising and they seem justified on theoretical consideration of this method. There are many possible variations in the number, strength, and position of the needles and in the size and strength of the tandem. It is the purpose of this study to calculate the distribution of radiation in several such schemes of radium implantation and to compare the results with those published for other methods of treating cervix carcinoma.

Theoretically this method is proposed to yield a wider distribution of radiation in the pelvis because of the introduction of the radium sources directly into the parametria. Furthermore, the use of many weak sources rather than a few strong ones will tend to produce a more uniform field of radiation and eliminate the danger of extensive necrosis around individual sources. This use of many weak sources has no relationship to the opinion sometimes voiced, that protracted low-intensity radiation may have a more pronounced physiological effect than shorter and more intense treatment. Actually the radiation may be delivered as rapidly (or even more rapidly) by means of many weak sources as by a few strong ones.

A uniform field of radiation and the avoidance of strong individual sources are important in the treatment of carcinoma of the cervix. It is quite necessary to avoid extensive necrosis and local over-irradiation, because of the morbidity and mortality associated with them. Tod (14) has shown that there is a definite relationship between over-irradiation of the so-called paracervical triangle and three-year survival rates. She emphasizes that there is an upper limit to the dosage that may be delivered to the region in the base of the broad ligament lateral to the cervix. Overdosage there brings a high percentage of "overdosage effects" and deaths. "... these deaths are not ... solely due to necrosis. They are due to recurrence which may either be local or a result of residual disease in the pelvic lymph nodes growing down into the pelvis. These facts have been verified by a number of post-mortem examinations .... This peculiar combination of necrosis and recurrence has been called in this Clinic [Christie Hospital and Holt Radium Institute] 'supralethal effect.'" Others have mentioned this effect but, so far as is known, no adequate explanation has been offered.

On the other hand, it has been brought out by several investigators (1, 9) that there is a definite relationship between lymph node involvement and the percentage of five-year survivals. No method of treatment, therefore, will increase the overall salvage unless it controls, not only the primary tumor, but also the field of lymphatic drainage. There are four groups of nodes along the course of lymphatic spread: the hypogastric nodes at the bifurcation of the common iliacs, the ureteric node at the crossing of the uterine arteries and the ureters, the obturator node at the entrance of the obturator canals, and the "ganglion principal" along the lateral pelvic wall halfway between the hypogastrics and obturators. It is generally considered that only 50 per cent of patients with carcinoma of the cervix are "operable" when they first apply for treatment, and in this group it has been found on serial sections that there is carcinoma-

[1] Accepted for publication in January 1943.

[2] National Cancer Institute Fellow.

tous extension to the nodes in about 50 per cent. Thus, only about 25 per cent of patients with cervix cancer are treated before this lymphatic spread has occurred (9). (One must presuppose that there is already lymphatic involvement in the inoperable cases.) The usual published survival rates for all stages of the disease approximate this 25 per cent. Hence it is highly desirable in all cases so to irradiate the parametria that a lethal dose will be delivered to the regional nodes, as it is impossible to tell by pelvic examination whether or not they are involved. This dose has been estimated as approximately 6,000 r_{γ} (2, 8).

From the clinical point of view there are several aspects of the use of needles that may seem dangerous for the patient. The introduction of infection from the vagina, the occurrence of fistulae, and injury to the ureters, are all logical fears. If there is an increase in morbidity and primary mortality out of proportion to the increase in survival rates, the use of interstitial needles should be avoided. Parametritis, fistulae, and ureteral stricture are, of course, common sequelae of carcinoma of the cervix treated by any method, or even not treated at all, and the statistics available on this subject do not show any notable increase with the use of needles. Pitts and Waterman (5), Arneson and Hauptman (4), and Teahan, Wommock, and Weatherwax (12), who have reported on the morbidity following the use of interstitial needles, conclude that it is not unnecessarily high.

As for the clinical results reported for such methods, Pitts and Waterman have the most extensive series. Details of their plan will be discussed below. They report a five-year survival rate of 36 per cent of 264 patients treated primarily with a tandem and interstitial needles, with a classification of 38 per cent of their patients as operable. These are indeed striking results. Arneson and Hauptman reported regression of the tumor in two-thirds of the 36 patients treated by this method. Of the 52 patients thus treated in the series reported by Teahan, Wommock and Weatherwax, 23 are dead and 29 are still living. Of the latter, 14 have survived one year or more and 15 are living less than one year after treatment. It seems that many investigators have used this method for dealing with recurrences of the tumor after primary treatment by other means, but it is not in general use as a primary therapeutic procedure. With wider use the method will be more easily evaluated as far as clinical results are concerned.

To be able to compare results of calculations of distribution of radiation for various arrangements of sources, it is necessary to set up certain standard conditions. Accordingly, the dimensions of the uterus and pelvis were taken from figures published as average in studies of this sort (2). The uterus is taken as $8 \times 5 \times 3.5$ cm. and is considered to contain a cervical tumor that does not involve the fornices or disrupt the regular outline of the organ. The bony pelvic wall is assumed to be 6 cm. from the midline at the level of the internal os, and the location of the "ganglion principal" nodes 5 cm. from the mid-line at the same level. The normal anteflexion and anteverison of the uterus are disregarded in the diagrams in order to eliminate confusion in comparison with other such figures. But it may be said that when radium is implanted with the patient in lithotomy position and in slight Trendelenburg, the uterus may well assume this position at the time of implantation.

The computations of the distribution of radiation for these implantations were made as follows. A diagram of the system to be examined was drawn in actual size on graph paper. In this diagram three transverse planes at different levels were taken and one sagittal plane through the mid-line of the tandem. The transverse levels were taken through the base of the broad ligaments, where the most accurate dosage determinations were thought necessary.

For each level the position of the implants was then laid off on a magnified

scale to facilitate the measurement of the distance from any point in that level to each of the sources. Then for each source (in the same magnified scale), a curve was drawn showing the variation of radiation from that source with distance. It was necessary, of course, to have different curves for each source at different levels; that is, as the transverse planes intersect the tandem or needles at center, end, or other region. It was also convenient to have different curves for each mg.-hr. exposure. These curves were taken from Quimby (6), and the percentage doses were transposed to read in r_γ. As the basis for this transposition the value of the radiation at 1 cm. from a point source of radium filtered by 0.5 mm. Pt was taken as 8.3 r_γ per mg. hr. (10). Hence for such a source, 1,000 r_γ are delivered at 1 cm. with an exposure of 120 mg. hr. For linear sources of various lengths, the corresponding doses are obtained from tables (6). With such graphs the dose at any particular distance from any individual source can be read directly in gamma roentgens and the doses from all sources summated to give the total delivered at any particular point.

In Arneson's first paper on this subject, he brought out the fact that the intensity of radiation around any radium source decreases so rapidly with increasing distance from that source that it would be confusing to indicate many isodose levels in the diagrams. Therefore, he chose to indicate the boundaries for 15, 7, 4 and 1 T.E.D.[2] These are important levels because clinical results may be correlated with them. Those tissues which receive 15 T.E.D. or more are liable to undergo necrosis and slough. Those receiving from 7 to 15 T.E.D. should have good control of tumor without the effect of overdosage. In the region between 4 and 7 T.E.D. some effective control should be obtained, while dosages below this will probably not be effective. For these reasons the isodoses to

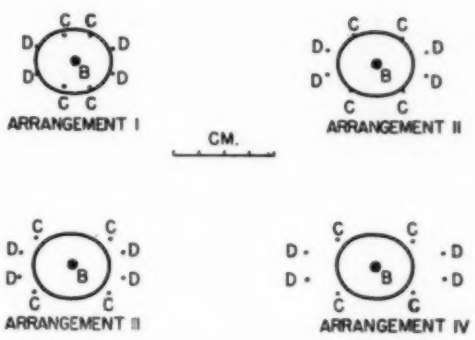


Fig. IA. Diagram of various arrangements of sources described in Problem I.

be indicated on the diagrams presented here were taken at 15,000, 7,000, 4,000, and 1,000 r_γ.

The first problem investigated dealt with variations in lateral position of both paracervical and parametrial needles; the second with variations in the angulation of these needles; the third with variation of mg.-hr. exposure. In the examples studied, it is necessary to postulate exact placing and angulation of the needles. It is realized that this cannot be achieved in practice. The purpose of this paper, however, is not to establish an exact treatment plan, but to investigate the trends of changes in radiation distribution with the variations mentioned, in the hope that this will lead to improvements in treatment methods.

In the first problem, the set of radium sources selected was that used by Arneson and Hauptman (4), namely, a tandem containing 37.5 mg. (2 capsules; 12.5 mg. above and 25 mg. below; 4 cm. total active length) combined with 4 paracervical needles, each of 2 mg. and 2 cm. active length, and 4 parametrial needles, each of 4 mg. with active length of 4 cm. The dose was calculated for a theoretical treatment time of 100 hr.[3]

[2] The T.E.D., or threshold erythema dose, was at that time the accepted method of stating radium dosage. At present such doses are preferably expressed in gamma roentgens, one T.E.D. being equivalent to 1,000 r_γ (7).

[3] In actual practice this scheme may be used for a larger dose without unusual deleterious effects; but here, as in any radium implant, the upper time limit is decided by the dose from the strongest source. In this case the strongest source is the tandem and, if necrosis is to be avoided, it is safer to keep this exposure below 4,000 mg. hr.

TABLE I: VARIATIONS IN POSITIONS OF CRITICAL ISODOSE LEVELS IN TRANSVERSE PLANE THROUGH INTERNAL OS

		Critical Isodose Levels in Gamma Roentgens							
		15,000	7,000	4,000	1,000	15,000	7,000	4,000	1,000
		Distance from Mid-Line in Mm.							
		Lateral				Anteroposterior			
Problem I: Variation in lateral position of needles (6,100 mg. hr.)	Arrangement I	11	23	31	40	13	21	24	40
	II	12	25	34	45	11	20	27	42
	III (Fig. I)	14	26	36	47	11	20	27	42
	IV	11	22	35	47	11	20	27	42
Problem II: Variation in angulation of needles (8,064 mg. hr.)	V (Fig. II)	21	33	40	60	18	29	39	60
	VI	16	32	40	57	18	29	37	57
Problem III: Variation in mg.-hr. exposure	VII (6,600 mg. hr.)	15	34	40	57	13	26	32	54
	VIII (7,920 mg. hr.) (Fig. III)	17	36	42	58	17	27	35	54

The mg.-hr. exposure for the tandem then will be 2,500 from the lower tube and 1,250 from the upper, and for the needles, 100 mg. hr. per centimeter of active length. The short needles are inserted parallel to the cervical canal, whereas the longer ones are angulated 30° from the frontal and from the sagittal planes in order to bring the effective radiation toward the pelvic wall. In this first problem the mg.-hr. exposure and the angulation of the needles at their points of insertion were kept constant. Only the sites of insertion were varied (see Fig. IA).

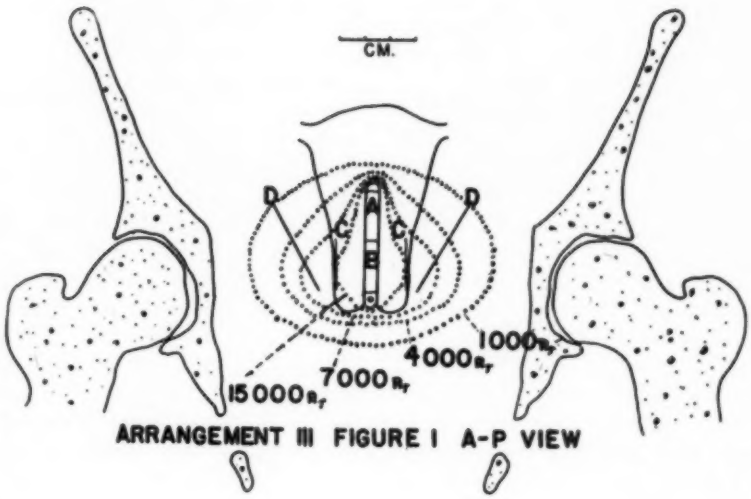
The needles are inserted with ends flush with the cervix at the reflection of the vaginal walls. In arrangement I the short needles are 1 cm. apart and lie in pairs anterior and posterior to the cervix. The long needles start 1 cm. apart and are inserted in pairs in the lateral fornices.

In the second arrangement the short needles are moved laterally so that they lie 2 cm. apart, with the same relationship anteroposteriorly. The long needles are inserted 0.5 cm. lateral to the cervix, but the same relationship to one another is maintained.

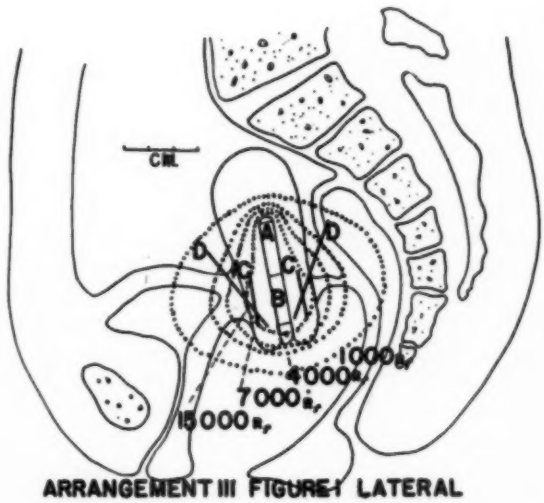
In the third plan the short needles lie 3 cm. apart in the lateral direction and 2 cm. anteroposteriorly, while the long needles are inserted in the same manner as in the second arrangement. (See Fig. I. This is the plan used by Arneson and Hauptman.)

In the fourth scheme there is no change in the smaller needles, but the longer ones are moved to be inserted 2.75 cm. lateral to the mid-line of the cervix.

In studying the isodose curves calculated for these schemes it was found that there is a slight but definite variation in radiation with changes in the position of the needles. To bring out this comparison, Table I has been prepared to show the position of the isodoses drawn with relation to a transverse plane passing through the level of the internal os. As the needles are moved laterally, the isodoses move laterally also, and this is compensated for by a decrease in their extent in the anteroposterior direction. This is desirable in treatment of the usual conditions, when there is extension into the parametria and where one does not want a large dose in the region of the bladder and rectum. Also, it is evident that there is an optimum lateral position of the needles as far as effective radiation is concerned. For in Arrangement IV, with the long needles 2.75 cm. from the mid-line, the extent of the effective curves is not so great as when they are only 2 cm. from the mid-line, as in Arrangement III. This is important, for, according to Sandler, 58 per cent of the vaginas he measured are less than 5 cm. in transverse diameter and 42 per cent are larger. The natural tendency to place the needles as far laterally as possible in every case will thus not always be the best with this type of implantation scheme. This finding is similar to Sandler's (10)



ARRANGEMENT III FIGURE I A-P VIEW



ARRANGEMENT III FIGURE I LATERAL

Fig. I. Arrangement III: Isodoses in gamma roentgens.

Source	Number	Length (cm.)	Strength (mg.)	Time (hr.)	Mg. Hr.	Percentage of Total
A	1	2	12.5	100	1,250	Tandem
B	1	2	25.0	100	2,500	61
C	4	2	8.0 (2 each)	100	800	Needles
D	4	4	16.0 (4 each)	100	1,600	39
	10		61.5		6,150	

concerning intravaginal corks and their lateral placement. He states that the hypothesis of Regaud, that one should aim at getting the radium as far out in the parametrium as possible, is not valid.

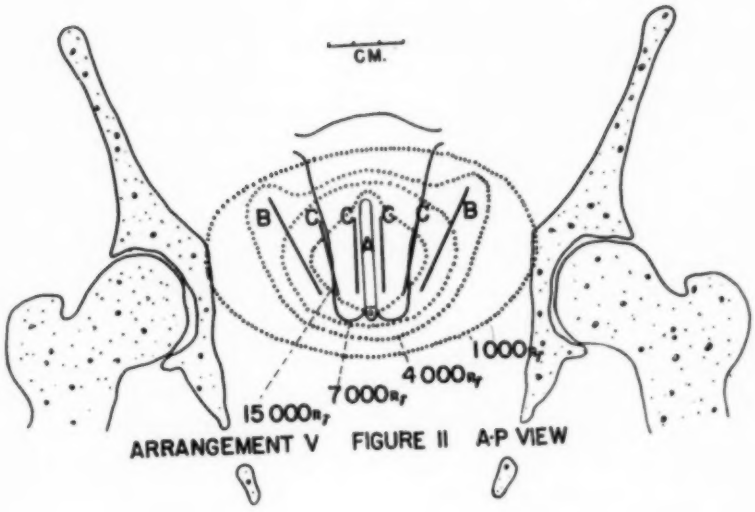
It seems probable that this combination of tandem and needles can be improved upon, and the first thing one would think of would be to use more needles and a weaker tandem. Pitts and Waterman have been using such a plan for several years, and calculations were made for a typical implantation outlined by Doctor Waterman (15). The factors used are as follows (see Fig. II): an intracervical tandem of 4 cm. in active length containing 20 mg. evenly distributed; eight 3-cm. needles containing 2 mg. of radium and four 4.5-cm. needles containing 3 mg., arranged in a circular fashion about the cervix—the longer needles inserted laterally in the parametria. The long needles are angulated at about 30° from the sagittal but are parallel in the frontal plane. They are 2 cm. from the mid-line and 1 cm. apart at their insertion and 4 cm. from the mid-line but still 1 cm. apart at their tips. Four of the shorter needles are inserted in pairs anterior and posterior to the cervix—1 cm. apart and 1.5 cm. from the mid-line. The other four lie in a mid-position 1.25 cm. from the mid-line laterally and 1 cm. in the anterior-posterior direction. These too have a slight angulation away from the sagittal and frontal planes (5°). The exposure time used by Doctor Waterman is 168 hours, so that the tandem gives 3,360 mg. hr. and the needles about 170 mg. hr. per cm. active length. The total dose corresponds to 8,064 mg. hr.

With the use of more needles and the increase in total radiation, there is a marked increase in the lateral range of the effective doses. But with this improvement it appears that the 15,000 r_γ isodose (the one within which necrosis may be anticipated) extends beyond the confines of the uterus at the level of the internal os. This is because the center of the uniform tandem is at this level, and with the proximity of the stronger lateral needles, this may lead to persistent radiation ulcers of the "dumbbell" type.

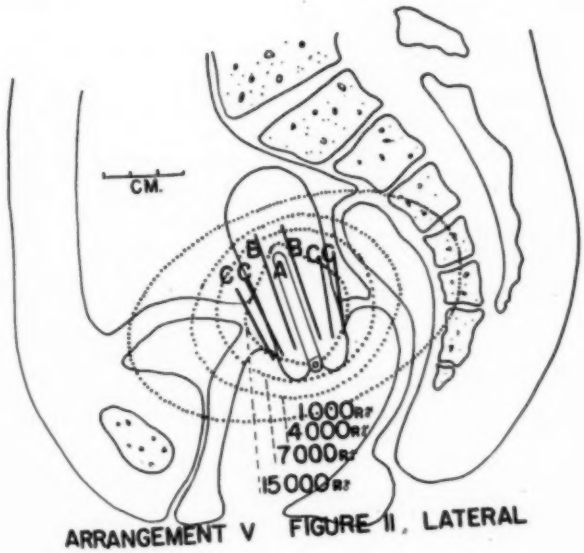
With this scheme it was decided to vary the angulation of the needles and to ascertain what effect this would have on the isodoses. Arrangement VI was drawn with the anterior and posterior sets of short needles parallel to the cervical canal; the intermediate short needles are angulated slightly and the longer ones are at a 30° angle from the sagittal and frontal planes. With this variation there was no change in the position of entrance of the needles or in the milligram hours from each.

Here, too, one finds a slight but definite variation in the curves. Because of the fact that the longer needles in the parametria spread away from one another, the summated radiation medial to them decreases and the higher isodoses do not extend so far laterally. As the needles veer away from one another, they carry a certain field of effective radiation with them, but this is much smaller than the field of two of them in proximity. This variation, however, seems to cause less change than variation in the lateral position of the needles.

Following these calculations, it seemed advantageous to develop a scheme of implantation based on the knowledge thus far obtained, which should be applicable to the radium supply available in most well equipped clinics. It was decided that the tandem should be stronger in its lower half than in the upper portion, and a tandem of 10 over 20 mg. was therefore postulated. Then, in order to have the radiation spread more in the lateral direction than in the anteroposterior, pairs of needles were placed as follows (Fig. III): two 2 cm.-2 mg. needles 1 cm. apart anterior and posterior to the cervix, two 3 cm.-3 mg. needles in the mid-way positions anterior and posterior to the cervix; two 4 cm.-4 mg. needles in the lateral positions, as in the Pitts and Waterman scheme. The lateral needles were angulated laterally but not anteroposteriorly. A hypothetical irradiation time of 100 hr. was again taken, which would give the exposure from the tandem



ARRANGEMENT V FIGURE II A-P VIEW



ARRANGEMENT V FIGURE II, LATERAL

Fig. II. Arrangement V: Isodoses in gamma roentgens.

Source	Number	Length (cm.)	Strength (mg.)	Time (hr.)	Mg. Hr.	Percentage of Total
A	1	4	20	168	3,360	Tandem
B	4	4.5	12 (3 each)	168	2,016	42
C	8	3	16 (2 each)	168	2,688	Needles
	13		48		8,064	58

a value of 1,000 mg. hr. plus 2,000 mg. hr. and the needles 100 mg. hr. per cm. active length. The total exposure is thus 6,600 mg. hr. The isodoses for this system show some improvement over the results from the Pitts and Waterman scheme in that the area receiving intense radiation is somewhat less and that receiving theoretically adequate radiation is slightly more in the lateral direction and slightly less in the anteroposterior.

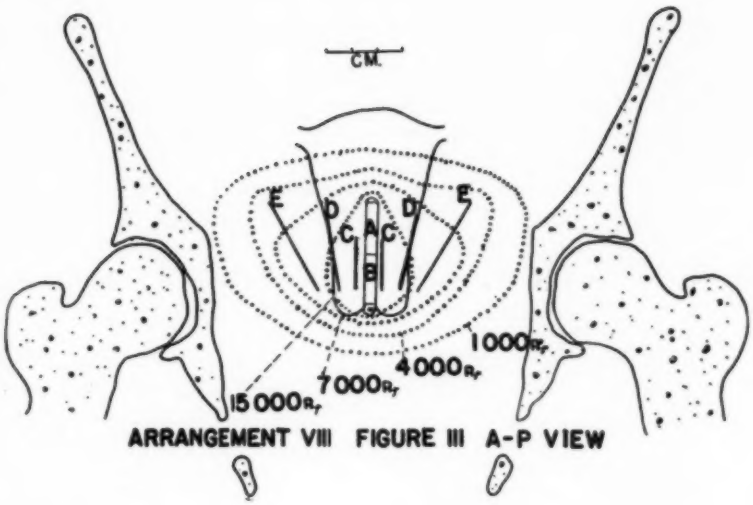
Since the radiation from this system is well below the limits of tolerance, a second calculation was done for the same set-up with an exposure time of 120 hr. This means 2,400 mg. hr. from the lower capsule and 1,200 mg. hr. from the upper one, and 120 mg. hr. per cm. active length for the needles, a total of 7,920 mg. hr. This is essentially the same as the 8,064 mg. hr. used by Pitts and Waterman. For this irradiation the calculated isodoses show a somewhat better distribution than those of these authors. The high intensity regions are smaller and the adequate radiation areas are wider. On studying the diagram, however, it is seen that the high intensity areas extend slightly past the limits of the cervical tissue. Hence it is evident that, while this irradiation should be tolerated, any further increase in exposure time would probably be dangerous in that it might lead to excessive necrosis.

It is of interest to compare the volumes of tissue lying between successive isodose surfaces, as the total dose is increased in the above problem. These volumes were calculated only for that tissue lying within the lower 3 cm. of the base of the broad ligaments.

For the first plan of treatment (6,600 mg. hr.) the volume within the 15,000 r_γ isodose level was 14.1 c.c.; that within the 7,000 r_γ isodose level was 71.0 c.c., and the volume between 7,000 and 15,000 r_γ level equals 56.9 c.c. With 7,920 mg. hr. the 15,000 r_γ level covers a volume of 17.6 c.c. and the volume within the 7,000 r_γ level equals 74.5 c.c., yet the volume between the levels remains 56.9 c.c. This indicates that the isodose shells spread outward in a proportionate degree with an increase in exposure.

With the use of interstitial sources in any lesion one always feels uncertain of the exact position of the implants. In general the exact position becomes of less importance as one increases the number of sources used and in doing so decreases the strength of each separate source. However, limits to the number of sources that can actually be used lie in the radium supply available and also in the available space in the vagina. An optimum scheme is desirable for the implantation of these needles in a regular and predetermined fashion for most of the patients treated. With problems of this sort in the past, guides have been suggested and designed to insure accurate implantation of the sources and also reduce the amount of handling necessary by the operator. Such a guide should be very useful in the treatment of Stage I and of most Stage II lesions. It is not essential, however. In fact, one of the advantages of the use of parametrial needles is flexibility and the fact that it tends toward individualization of the treatment. If it seems desirable to treat one parametrium more than another, the needles can be arranged accordingly. If the lesion is very large, or if vaginal extension has occurred, more needles can be placed where necessary. With unusual lesions the variations in radiation would seem less important than the value of individualization.

It is of interest to compare the radiation around interstitial implantations of this type with that obtained from the use of intracervical tandems with intravaginal sources. In Table II such comparisons are made for several of the usual methods on the basis of r_γ delivered at points in the parametria, 2, 3.5, and 5 cm. lateral to the mid-line in a transverse plane through the internal os. The discrepancy between the figures given for Arneson's calculations for tandem with colpostat and those he originally published is due to the basis on which his curves were drawn. In 1936, when his paper was published, the value of the



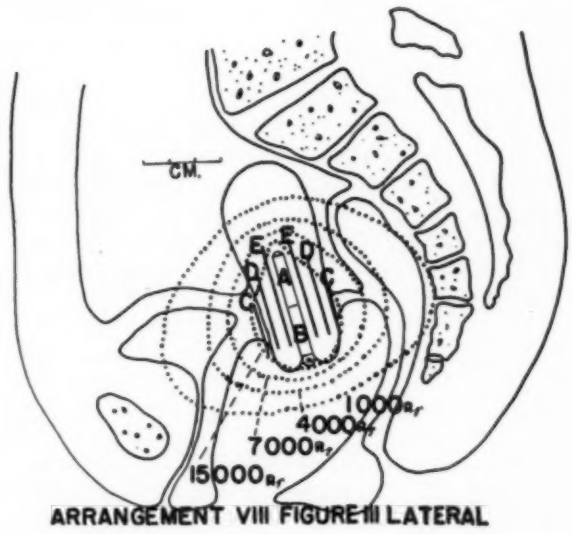


Fig. III. Arrangement VIII: Isodoses in gamma roentgens.

Source	Number	Length (cm.)	Strength (mg.)	Time (hr.)	Mg. Hr.	Percentage of Total
A	1	2	10	120	1,200	Tandem
B	1	2	20	120	2,400	45
C	4	2	8 (2 each)	120	960	Needles
D	4	3	12 (3 each)	120	1,440	55
E	4	4	16 (4 each)	120	1,920	
	14		66	120	7,920	

TABLE II: DOSES (IN r_γ) AT CERTAIN DISTANCES LATERAL TO MID-LINE OF TANDEM IN TRANSVERSE PLANE THROUGH INTERNAL OS

Technic	Calculator	Mg.-Hr. Exposure	Distance 2 Cm.	Distance 3.5 Cm.	Distance 5 Cm.
TANDEMS WITH INTRAVAGINAL SOURCES					
Arneson	Nolan and Quimby	5,000	7,000	3,500	1,000
Stockholm	Tod and Meredith	8,000	5,400	...	1,800
Marie Curie	Sandler	5,280	....	3,000	1,680
Paris	Sandler	7,200	....	4,500	2,250
Paris	Tod and Meredith	8,000	6,150	...	2,500
Manchester	Tod and Meredith	6,600	7,200	....	2,400
Manchester	Sandler	11,000*	....	7,000	4,250
TANDEMS WITH INTERSTITIAL SOURCES					
Arneson and Hauptman (Fig. I, Arrangement III)	Nolan and Quimby	6,100	10,000	4,000	1,000
Pitts and Waterman (Fig. II, Arrangement V)	Nolan and Quimby	8,000	15,000	6,500	3,000
Teahan, Wommack, and Weatherwax	Nolan and Quimby	11,500	....	7,500	4,000
Reinhard, Goltz, and Schreiner†	Reinhard	6,000	7,300	3,000	1,500
Nolan and Quimby (Arrangement VII)	Nolan and Quimby	6,600	11,000	6,800	2,500
Nolan and Quimby (Fig. III, Arrangement VIII)	Nolan and Quimby	8,000	12,000	7,200	3,000

* Two sets of treatments, 3 weeks apart.
† Tandem with interstitial radon seeds.

T.E.D. was taken as the radiation at 1 cm. distance from a point source with 0.5 mm. Pt filter for 100 mg. hr. Subsequent study has proved this value to be much too low. The figures given in the table show the doses, at the points mentioned, for Arneson's arrangement when calculated on the basis of the present paper. The others show fairly close agreement. From the calculations presented here it appears that there is a marked improvement in the parametrial dose obtainable by the use of interstitial needles over the use of intravaginal sources with intracervical tandems.

In order to compare the three methods of interstitial irradiation described here with one another and with other methods of treating cervix carcinoma, Fig. IV has been prepared to illustrate the variations graphically. On one co-ordinate are shown tissue doses in gamma roentgens with the significant doses indicated. On the other co-ordinate, distances in centimeters lateral to the mid-line of the cervix in a transverse plane taken through the internal os are shown. Reference lines have been drawn to show one position of the lateral border of the cervix, the extent of the parametrium, the position of the pelvic lymph nodes, and the medial border of the pelvic wall.

As an example of methods of radium treatment other than needles, the Manchester method described by Sandler, Tod, and Meredith has been selected. From published reports it seems to be the most effective of those methods which employ a tandem with intravaginal sources. The points plotted for this method in Fig. IV are calculated on a basis of an 8,000 mg.-hr. exposure time. From the curve shown it can be seen that the tissue doses that may cause necrosis are limited well within the cervix. The extent of the effective doses in the lateral direction at the level of the internal os, however, is not great.

In comparing the curve for the Manchester method with that for the method of Arneson and Hauptman (and the latter is on a basis of only 6,200 mg. hr.), it is evident, that, while the excessive doses will still fall within the limits of the cervix, the area of good control is wider at this level for the latter method. Farther laterally the effect of the higher mg.-hr. exposure of the previous scheme becomes manifest.

Inspection of the curve for the method of Pitts and Waterman reveals that there may be some danger of overdosage at the level of the internal os, as the higher doses extend beyond the confines of the cervix. With this method, however, there is a more obvious increase in the lateral extent of the effective dose ranges.

In the modification suggested by the

authors an attempt was made to decrease the lateral extent of the higher dosage values and still maintain the lateral spread of the tumor-controlling ones. Comparison of the curve for this method with that for the method of Pitts and Waterman shows that this is accomplished with the same mg.-hr. exposure as theirs.

It is evident from this illustration (Fig. IV) that, if 6,000 r_γ is the minimum cancer lethal dose, none of the technics considered here is adequate for treatment of possible pelvic lymph node involvement. Supplementary irradiation with x-rays is essential to bring up the dosage level in this region. The question of actual dosage from x-rays is outside the scope of this paper.

culated for several combinations of intracervical tandems and interstitial needles. Variations in these combinations as to lateral position, angulation, and mg.-hr. exposure have been studied. It has been noted that with these variations there are changes in the fields of radiation, and these changes, although small, are thought to be significant. Their significance lies not in differences of a few millimeters, but in the concepts they teach. In the calculations it was necessary to postulate exact placing and angulation of the needles. It is realized that this cannot be achieved in practice. The purpose of this study, however, is not to establish an exact treatment plan, but to investigate the trends of changes in radiation distribution with the variations mentioned, in the hope that this will lead to improvements in treatment methods.

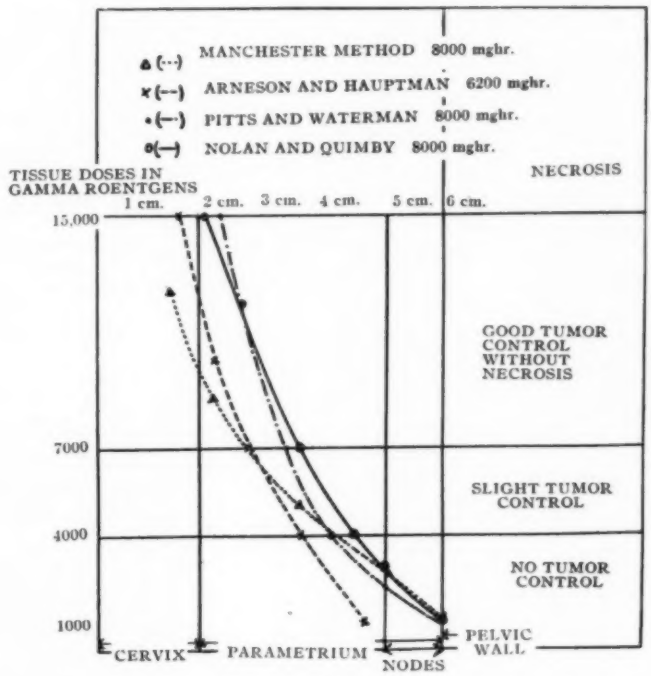


Fig. IV. Comparison of various methods of irradiation in cervix carcinoma. The distances lateral to the midline in a transverse plane through the internal os are indicated by the figures at the top of the chart, 1 cm., 2 cm., 3 cm., etc.

SUMMARY

The fields of radiation have been cal-

The authors are indebted to Doctor Arneson for suggesting this problem. They wish to acknowledge the courtesy of Doctor Pitts and Doctor Weatherwax in personal communications regarding certain points. They also wish to thank Mr. John Walke for his assistance in the preparation of the figures.

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CASE REPORTS

Long Pulmonary Retention of Lipiodol[1]

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Pasadena, Calif.

In the roentgen examination of the bronchial tract the use of lipiodol is common. Among the many hundreds of patients in which it has been employed, no reaction has been recorded. Wright (1) has reported one case in which there was retention of the opaque oil for a period of one year. At the time of instillation of the oil one of the main branches of the right bronchus was almost completely blocked. The oil passed beyond the obstruction into the lower branches, but was unable to pass toward the trachea. In this case death occurred and at autopsy no epithelial reaction was found. The following is quoted from the autopsy report: "When the lipiodol is removed by a fat solvent and the section counterstained by eosin, the areas where the lipiodol occurred are seen to be made up of a lacework of finely reticulated cells with small round nuclei. The cytoplasm is extremely scanty, slightly vacuolated and extending in fine interconnecting strands from one cell to another. No collagen fibrils were demonstrated arising from these cells. The lipiodol appears to be inclosed in a form of cellular syncytium. The origin of these cells is probably the supporting tissue of the bronchus."

The following case, in which lipiodol has been retained for more than two years, without apparent obstruction, appears to be unique.

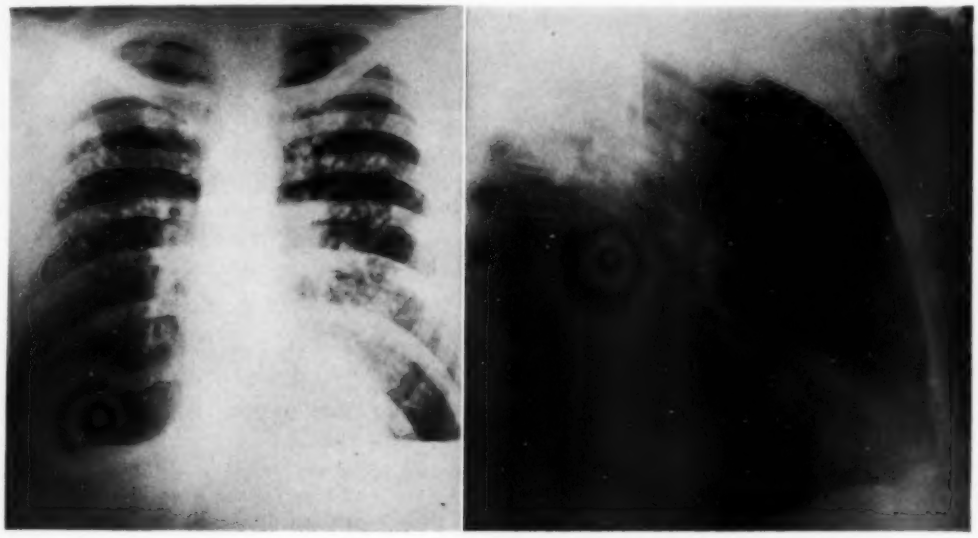

Fig. 1. Roentgenograms showing retained lipiodol.

W. L., white male, age 44, was referred for roentgen examination of the chest on Dec. 21, 1939. At this time, except for one calcified nodule in the right middle lobe his lungs were essentially clear. The left costophrenic angle did not open well, because of adhesions from a former pleurisy. Stereo films made in 1931, brought by the patient for comparison, showed similar findings.

In April 1940, the patient entered a hospital for observation, and the use of lipiodol was advised to rule out the presence of bronchiectasis. The patient stated that he could not use iodine because of being allergic to the drug. After the administration of an opiate, however, lipiodol was instilled into the bronchi through a catheter placed in the trachea. No bronchiectasis was found and he was discharged

[1] Accepted for publication in October 1942.

from the hospital two days later. Two or three days after arriving home his hands became very edematous, and his eyes were swollen shut. He had chills, a high temperature, and rapid pulse, was very weak, and said that his stomach felt at times "as if it were dropping." He called a physician, who sent him to another hospital. Here he was admitted with the following diagnoses: angioneurotic edema, with urticaria; moderately advanced chronic pulmonary tuberculosis, inactive; left pleural adhesions; chronic bronchitis secondary to tuberculosis.

According to the patient's statement his temperature was 103 to 105° for a period of three weeks, during which time his weight dropped from 125 to 110 pounds. He remained in the hospital six weeks.

In February 1942, the patient was referred for another chest examination. At this time, posteroanterior films showed many areas of thin opaque density in both lungs. These were particularly prominent in the right lung near the lateral chest wall and in the left lung near the hilum. In the lateral projection these opacities were seen to be in the midportion of the lung. They did not have the typical appearance of tuberculous lesions, in that the central portion was less dense than the periphery; in tuberculous calcifications the greater density is in the central part.

The patient was last seen in April 1942, at which time the shadows still persisted.[2]

The shadows seen in the chest in the case just described are those of an opaque substance lining the bronchioles. The iodine is evidently fixed in the bronchiolar tissues. This, I believe, is due to an allergy, since lipiodol usually drains quite promptly from the bronchial tree. Because of the temperature, lipoid pneumonitis must be considered, but none of the numerous reports of lipoid pneumonitis has shown this condition to be due to sesame seed or poppy seed oil, which is used in the preparation of lipiodol. More often it is found following long-continued use of mineral oil, and very often when the patient is undernourished.

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[2] The patient was again seen on March 18, 1943, and evidence of lipiodol retention was still present.

Osteopathia Condensans Disseminata (Osteopoikilosis)[1]

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Osteopoikilosis, osteopathia condensans disseminata, osteopoecilia, osteosclerosis fragilis generalisata, or Albers-Schönberg disease, is a pathologic condition of the skeleton characterized by the presence of multiple, small, widely disseminated areas of compact bone. It is probably a congenital anomaly of hereditary background. Following the report of a lesion in the cranium by Erbsen, in 1934, involvement of almost every bone has been recorded, with the exception of the spinal column and ribs. The lesions have been observed, in order of frequency, in the pelvic bones, femoral heads, humeral heads, metacarpals, phalanges and carpals, metatarsals, phalanges and tarsals, femoral condyles, proximal radius and ulna, scapula, and patella. More rarely, they have occurred in the clavicle, mandible, and cranium.

The disease is usually diagnosed during roentgenographic examination for some other condition, such as trauma. It occurs in both sexes, somewhat more frequently in males, and is without symptoms.

Albers-Schönberg is generally credited with first having reported the disease in 1915, but Bloom states that the first authentic account was that of Stieda, in 1905.

ETIOLOGY

The congenital origin of the process has been demonstrated by the appearance of

[1] From the Department of Roentgenology, Michael Reese Hospital, Chicago. Accepted for publication in December 1942.

Fig. 1. Osteopathia condensans disseminata: typical lesions in the distal humerus and proximal radius and ulna.

typical changes in a child eighteen days after birth, as recorded by Bermuth. Heilborn, in discussing a paper by Steenhuis, stated that he had observed osteopoikilosis in a four-month fetus, while Keyser, discussing the same paper, said that he had seen the condition a few days after birth.

The hereditary factor has been mentioned by different writers, who have cited the occurrence of several cases in a single family.

Numerous theories as to the cause of the condition have been advanced. Voorhoeve believed that osteopoikilosis and dyschondroplasia were related, while Köhler quotes an author with having advanced the theory that the disease develops upon the basis of a rachitic osteomalacia. Tuberculosis, typhoid fever, scleroderma, hypothyroidism, hypopituitarism, syphilis, emboli, diabetes, parathyroid disturbance, and disseminated lenticular dermatofibrosis have been observed in patients with osteopoikilosis, and each has therefore been suggested as the etiological factor. Köhler states that most authorities seek "the cause of the disease in an abnormal calcium metabolism in intrauterine life, continued into post-natal life."

PATHOLOGY

The roentgenographic picture of osteopoikilosis shows compact bone, appearing as white oval areas of increased density in the spongiosa, varying from 2 mm. to 1 cm. in diameter, fairly well circumscribed, with irregular frayed edges, often appearing to overlap or coalesce.

Gross examination of bone sections by Schmorl revealed areas of increased density from the size of a pepper grain up to 1 cm.

Fig. 2. Osteopathia condensans disseminata: identical lesions in the tarsal, metatarsal, and phalangeal bones of the foot.

in diameter, irregular in contour and grayish-white in color. Stieda, in 1905, found that microscopically the bone nuclei were "composed of compact islands of corpuscles and lamellae in irregular arrangement, while the surrounding bone shows the haversian canals and lamellae to be well defined."

Stubenrauch concluded from his histological studies that osteopoikilosis develops by endochondral ossification and attempted to show that the areas may be due to remnants of cartilage in the epiphysis or to small islands of intermediary cartilage.

Newcomet observed no roentgenographic change in his case during a period of four years, while Baker and Jones found no

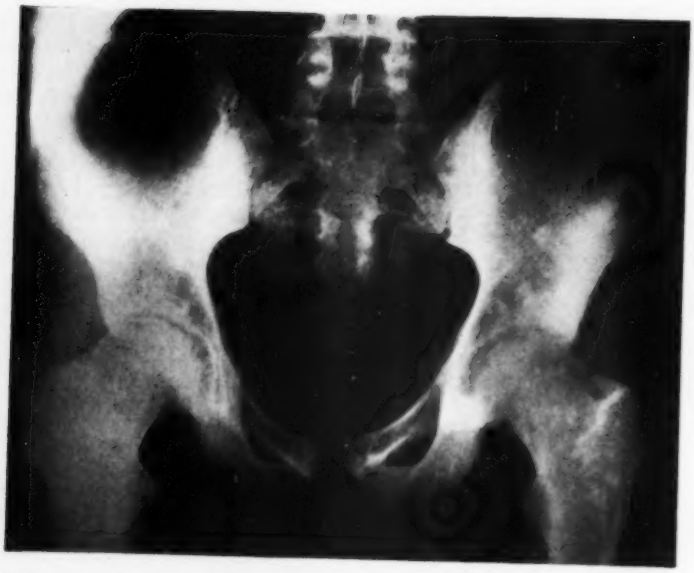

Fig. 3. Osteopathia condensans disseminata: dense deposits in the proximal humeri, acetabula, pubes, and in the sacrum.

Fig. 4. Osteopathia condensans disseminata: deposits in the distal forearm and in the hand and wrist.

roentgen changes in their patient during five years of observation, though they did note disturbance of epiphyseal growth. The case reported by Nichols and Shiflett showed no changes over a period of seven years.

The case here recorded was found roentgenographically by chance, during an examination of the wrist following trauma. When the lesions of osteopoikilosis were noted, the patient was asked to permit further roentgen and hematologic studies to be made, and readily agreed.

CASE REPORT

A. B., student, age seventeen, was born in Germany and had recently entered the United States. He is one of three children, the youngest a boy of fifteen and the eldest a boy of twenty. The mother and father are both alive and well. The family, with the exception of the patient, still resides in Germany.

The patient appeared well nourished, well developed, and normal to all outward appearances. He gave a history of measles and mumps in childhood

Laboratory examination revealed the following: hemoglobin, 90 per cent; erythrocytes, 5,100,000: leukocytes, 9,400, with 49 per cent neutrophilic polymorphonuclears, 43 per cent lymphocytes, 5 per cent monocytes, and 3 per cent basophilic polymorphonuclears. Blood chemistry examination showed glucose 75 mg. per 100 c.c., non-protein nitrogen 47 mg. per 100 c.c., calcium 12.0 mg. per 100 c.c., phosphorus 1.8 mg. per 100 c.c., and phosphatase 2.0 Bodansky units. Wassermann and Kahn reactions were negative, as was examination of the urine.

Roentgen examination, including the entire skeleton, showed lesions in all the bones with the exception of the skull, cervical, thoracic and lumbar spine, scapulae, ribs, and clavicles. The lesions were more marked at the distal ends of the bones, but not involving the articular surfaces. The carpal and the tarsal bones contained numerous lesions. In agreement with cases reported in the literature, this patient showed no evidences of change or progression in the lesions over a period of two years.

NOTE: Since preparation of this report, the author has seen another case of osteopoikilosis in a female patient twenty-seven years of age. Lesions were seen throughout the pelvis, in both hips, and in both shoulders. A diagnosis of possible osteoblastic metastatic cancer had been made elsewhere, seven years previously. The lesions had not changed in size or number at the last examination.

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EDITORIAL

Howard P. Doub, M.D., Editor

John D. Camp, M.D., Associate Editor

Atypical (Virus) Pneumonia

During the past seven years there have appeared in the medical literature a number of reports of pneumonia cases which reacted atypically and from which no absolute etiologic agent could be isolated. As these reports were studied and observations were correlated, a clear-cut clinical picture emerged, so that a diagnosis was possible even in the absence of etiologic proof. Numerous names have been applied to this condition, of which "virus pneumonia" and "atypical bronchopneumonia" are in more common use.

This unusual and relatively new syndrome was the subject of a complete symposium at the Annual Meeting of the Radiological Society of North America, in 1942. The papers comprising that symposium are published in this issue of RADIOLOGY. We wish here to call attention to them and to indicate briefly some of the salient points which are brought out.

The etiology has been one of the most elusive factors in the proper classification of this condition. Rhoads calls attention to the fact that several viruses may be active agents in epidemics of the disease. One virus which was isolated bore a close relationship to the viruses of lymphogranuloma venereum and psittacosis. It has been found, also, that the virus can readily be transmitted from one mongoose to another, though ordinary laboratory animals show a high degree of resistance. Rhoads was able to transmit the disease from a patient to a mouse and thence to other mice. The culture showed evidence of *Streptococcus viridans*. Unfiltered material was found to produce much more pronounced changes in the lungs of mice than the same material after filtration.

Saphir describes the difficulty, from the pathologist's standpoint, of proving a virus to be the unquestionable etiologic agent. He points out that many believe that the influenza epidemic of 1918–19 was of virus origin and that the presence of organisms in the sputum does not rule out the simultaneous presence of a virus which may have been the sole cause of the disease. It is well known that virus diseases are highly contagious and are especially dangerous to laboratory workers. Saphir found the lung changes to consist essentially of an interstitial pneumonia, although in the more severe cases the alveoli are also involved. The exudate consists mostly of mononuclear elements, in contrast to that of lobar or bronchopneumonia. When the alveoli become involved, a hyaline-like ring forms within them, thus interfering with the free exchange of gases.

There is a rather general agreement among all observers as to the clinical picture in these cases. Many of the patients are not extremely ill and recover rapidly with minimum physical and roentgen signs. Those who are more severely ill usually have a dry, unproductive cough, with chilliness rather than true chills, fever, and general malaise. Severe headache of distressing proportions is present in a large number of cases; dizziness, drowsiness, and slight mental confusion were observed by Rhoads in a number of instances. In cases with mild symptoms the temperature varies from

100 to 103° F., but in the more seriously ill it may rise to 105°. There is usually a relatively slight bradycardia as compared to the temperature rise. The respiratory rate is also low except in severe cases.

The physical findings are often insignificant and lag behind the roentgenologic changes. There may be râles over the affected areas with a slight dullness, and in a few cases bronchial breathing has been elicited. These are usually not early findings. In most instances no significant organisms are found in the sputum. The leukocyte count is relatively low compared to that in pneumococcus pneumonias. It varied in Rhoads' series from 7,000 to 11,000, with an average of 10,600.

Roentgen study usually offers the first positive evidence of lung involvement but is not always definite. Curtzwiler and Moore call attention to the fact that the diagnosis cannot be made on either the clinical course or roentgen findings alone.

McCarthy classifies the cases into 4 groups on the basis of the roentgenologic appearances. In Group 1 the earliest change is hilar enlargement with increased prominence of the linear markings. Later there is development of parenchymal density, somewhat less than that seen in lobar pneumonia, with linear lung markings visible through it. In Group 2 cases the patchy involvement of a single lobe is suggestive of bronchopneumonia. This type shows rapid resolution. Group 3 is an interesting group in which the infiltration radiates from the hilar region, closely simulating tuberculosis. Curtzwiler and Moore also call attention to this type and warn against a roentgenologic diagnosis without study of the clinical picture. Anyone who has seen many of these cases will undoubtedly recall mistakes of his own. Group 4 comprises those cases with extensive lung markings and multiple small parenchymal lesions somewhat simulating miliary tuberculosis.

One feature of the roentgenologic picture has been the tendency to spread in the same lung or to the opposite lung. In some cases the original lesion is clearing while the newer lesion is developing. Pleural changes are infrequent and pleural fluid is rarely present.

All agree that chemotherapy is of no avail in the uncomplicated cases but may have some effect on those with a superimposed pneumococcus infection. The mortality in all published series has been low, only a few deaths having been reported. In this series 4 deaths are recorded, but it must be remembered that the difficulties in the way of an exact pathological diagnosis are in most hospitals almost insurmountable.

The contributors to the symposium published here present an unusually well rounded description of all phases of this important disease, which may appear in epidemic form. It is of particular importance for the roentgenologist to be cognizant of the lung changes, since in many instances he is the first to detect the infiltration that leads to the diagnosis.

The Passing of the Cambridge Diploma

Under the above title Dr. A. E. Barclay,[1] in the *British Journal* of *Radiology*, draws attention to the fact that the University of Cambridge has rescinded the regulations for the Diploma in Medical Radiology and Electrology, effective October 31, 1942. All American radiologists, and more particularly those who have acquired the diploma, will hear of this action with regret.

Doctor Barclay gives a brief account of the beginnings of radiology and the struggle of its pioneers to establish it as a separate specialty, describing graphically the usual hospital quarters and inadequate equipment of the early radiologic department, a picture with which we are all familiar. World War I helped to highlight the value of x-ray studies, the need of well trained radiologists, and the lack of training facilities. A group of prominent radiologists of Great Britain, accordingly, realizing the importance of putting their specialty on a sound basis, petitioned Cambridge University to institute a diploma course. The first course was opened in 1920 and the first examination was given in July of that year. From the onset the course was extremely popular, taxing the available teaching facilities. Soon candidates for radiologic posts were required to hold the Cambridge Diploma and thus the status of the radiologist as a qualified specialist was firmly established. More than 500 candidates, coming from all parts of the world, have now taken this diploma by examination.

It is fortunate that through the years other universities have instituted similar diploma courses so that a continuing course of training has been established. In our country the American Board of Radiology has served as an examining body, thus establishing a standard of minimum requirements for the status of specialist in radiology. To these examining bodies which have helped place it on the firm foundation that it occupies today, Radiology owes a debt of gratitude.

[1] Barclay, A. E.: The Passing of the Cambridge Diploma. Brit. J. Radiol. **40**: 351–354, December 1942.

AMERICAN BOARD OF RADIOLOGY

The next examination of The American Board of Radiology will be conducted June 3–5, at the Palmer House, Chicago. This examination precedes the Teachers' Conference of Radiology and the annual meeting of the American College of Radiology for members, Fellows, and guests, to be held on Sunday, June 6, at the Palmer House.

CANCER TEACHING DAY

Academy of Medicine, Rochester, N. Y.

Cancer Teaching Day will be observed at Rochester, N. Y., on April 15, 1943, under the auspices of the Medical Society of the County of Monroe, Seventh District Branch of the Medical Society of the State of New York, Rochester Academy of Medicine, University of Rochester School of Medicine and Dentistry, Tumor Clinic Association of the State of New York, Medical Society of the State of New York, New York State Department of Health, Division of Cancer Control.

The Afternoon Session, beginning at 4:15 P.M., will be under the chairmanship of Dr. J. Craig Potter. The speakers will be Dr. Norman Treves and Dr. Fred W. Stewart, of Memorial Hospital, New York, whose subjects will be "Care of the Advanced Cancer Patient" and "What May Be Logically Expected from Pre- and Post-Operative Radiation in Mammary Cancer."

The Evening Session, with Dr. Leo F. Simpson as chairman, will be addressed by Dr. Cornelius Rhoads, Director of Memorial Hospital, New York, on "Role of the Endocrines in Neoplastic Disease," and by Dr. Charles B. Huggins, of the University of Illinois, on "Diagnosis and Treatment of Prostatic Cancer."

PENNSYLVANIA RADIOLOGICAL SOCIETY

The Annual Meeting of the Pennsylvania Radiological Society will be held on May 15 and 16 at the Brunswick Hotel, Lancaster.

DR. DAVIS SPANGLER HONORED

Dr. Davis Spangler, of Dallas, Texas, Second Vice-President of the Radiological Society of North America, has recently been elected to the presidency of the Dallas County Medical Society. Members of the Radiological Society will be in hearty accord with the closing paragraph of the announcement in the *Dallas Medical Journal*.

"We congratulate the Dallas County Medical Society in having as its head, during these perilous times, a man who is conscientious in his efforts and has demonstrated his ability as Doctor Spangler has."

In Memoriam

JOSEPH FRANCIS ELWARD, M.D.

1890–1943

Dr. Joseph Francis Elward of Washington, D. C., a member of the Radiological Society of North America and one of its Counselors died on Feb. 6, 1943.

JOSEPH FRANCIS ELWARD, M.D.

Dr. Elward was born in Plains, Penna., in 1890. He was graduated from the Philadelphia College of Pharmacy and Science and from Georgetown University Medical School. He was roentgenologist of Sibley Memorial Hospital and of George Washington University Hospital, in Washington, and Clinical Instructor in Radiology in George Washington University. He was a member of the American Association for the Study of Neoplastic Diseases, the American College of Radiology, and the American Roentgen Ray Society.

Dr. Elward contributed extensively to the radiological literature. The list of his contributions is evidence of the breadth and variety of his interests. Writing of him, Dr. P. F. Butler says: "He held to the sound idea that we are physicians first and specialists next. This gave him the opportunity to make use of his wide knowledge of collateral medicine, thus greatly enhancing his value as a specialist. He showed his versatility in his writings and lectures, most of them original contributions."

HENRY JACOB POOL, M.D.

1875–1943

Word has been received of the death, on Feb. 17, of Dr. Henry Jacob Pool, of Port Clinton, Ohio. Doctor Pool was born in Toledo, Ohio, and received his M.D. from the University of Wooster. He began practice in Port Clinton in 1902 and there established the Pool Hospital. He was a Fellow of the American College of Surgeons and a member of the Radiological Society of North America.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

SELECTED PAPERS FROM THE ROYAL CANCER HOSPITAL (FREE) AND THE CHESTER BEATTY RESEARCH INSTITUTE. Vol. 1, 1935–39, comprising reprints of articles from various journals. 484 pages.

INDUSTRIAL RADIOLOGY. X-RAYS AND GAMMA RAYS. By ANCEL ST. JOHN AND HERBERT R. ISENBURGER. Second edition. A volume of 298 pages. Published by Chapman and Hall, Limited, London, and John Wiley & Sons, Inc., New York. Price $4.00.

Book Review

CHANGES IN THE KNEE JOINTS AT VARIOUS AGES. By GRANVILLE A. BENNETT, M.D., Associate Professor of Pathology, Harvard Medical School, HANS WAINE, M.D., Research Fellow in Medicine, Harvard Medical School, Graduate Assistant in Medicine, Massachusetts General Hospital, and WALTER BAUER, M.D., Associate Professor in Medicine, Harvard Medical School, Physician to the Massachusetts General Hospital, Director Robert W. Lovett Memorial Foundation for the Study of Crippling Diseases. A volume of 97 pages with 9 figures and 31 plates. Published by The Commonwealth Fund, New York. Price $2.50.

This monograph is based on a study of knee joints from sixty-three persons, from one month to ninety years of age, the specimens being obtained at postmortem examination or after amputations. None of the records mentioned any complaints referable to the joint. Roentgenologic, macroscopic, and microscopic studies were made of each joint. Normal developmental and pathologic findings were carefully recorded according to the decade of life, and findings in the menisci, contact and noncontact portions of the cartilage, the subchondral bone with special reference to early formation of osteophytes, the synovia, subsynovial tissue, and the blood vessels are reported in detail.

Microscopic changes in the articular cartilage occurred as early as the second decade in the contact portions on the patella and femur, in the weight-bearing contact parts on the femur and tibia, and in the menisci. Macroscopically a few irregularities were seen in the cartilage in the second decade of life but by the third decade there were linear grooves and ridges, strips and shreds of superficial cartilage which were partially detached. Subchondral changes in bone did not occur until after thinning of the cartilage. The earliest subchondral changes were seen in the fourth decade; the marrow spaces in the bone beneath the regions of thinned cartilage were filled with cellular hyperemic fibrous tissue, and the number of osteoblasts and osteoclasts was increased. In every instance this reaction led to increased density of the subchondral bone. Microscopic evidence of lipping was apparent in one case in the fourth decade of life, but roentgenologic evidences of spurs were not regularly apparent until the sixth, seventh, and eighth decades. Changes visible in the roentgenograms were minimal compared with the gross findings of damage in the cartilage. The synovial membranes by the fifth decade revealed minimal villous hypertrophy and perivascular lymphocytic infiltration beneath the synovial lining. These findings were more apparent in the sixth, seventh, and eighth decades. Arteriosclerosis had no apparent relation to the amount of articular damage.

Following the description of the anatomic changes, the authors discuss the concepts of pathogenesis and considerations of etiology on the basis of their own findings and a comprehensive study of the work of others. They present evidence that the changes in the hyaline cartilage are due to a degenerative process. Regardless of many etiologic factors which have been suggested, the fundamental considerations are the biologic disadvantage of cartilage when injured, which is evidenced by its paucity of cellular constituents and remoteness from blood supply, and the mechanical stress incident to joint function. Subchondral changes in the bone and spurs do not appear until after the cartilage is considerably injured.

This monograph is a comprehensive and critical review of the literature and presents a careful study of the development of hypertrophic (osteo)arthritis. Every rheumatologist should study this volume, and others interested in the treatment of arthritis will find in it much fundamental information.

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit, Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Building, Syracuse, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago, Ill.

Section on Radiology, American Medical Association—Secretary, J. T. Murphy, M.D., 421 Michigan St., Toledo, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary-Treasurer, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Joseph D. Coate, M.D., 434 Thirtieth St., Oakland.

Los Angeles County Medical Association, Radiological Section.—Secretary, Donald R. Laing, M.D., 65 N. Madison Ave., Pasadena. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary-Treasurer, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Society meets annually during annual meeting of the California Medical Association.

San Francisco Radiological Society.—Secretary, Earl R. Miller, M.D., University of California Hospital. Meets monthly on third Thursday at 7:45 P.M., for the first six months at Toland Hall (University of California Medical School); second six months at Lane Hall (Stanford University School of Medicine).

COLORADO

Denver Radiological Club.—Secretary, Edward J. Meister, M.D., 366 Metropolitan Bldg. Meetings third Friday of each month at the Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary-Treasurer, Max Climan, M.D., 242 Trumbull St., Hartford. Meetings bimonthly, on second Thursday. Place of meeting selected by Secretary.

FLORIDA

Florida Radiological Society.—Acting Secretary, Walter A. Weed, M.D., 204 Exchange Building, Orlando.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta. Meetings twice annually, in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Warren W. Furey, M.D., 6844 S. Oglesby Ave. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., Louisville City Hospital, Louisville. Meeting annually in Louisville, third Saturday afternoon in April.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary-Treasurer, R. W. Cooper, 940 Margaret Place. Meetings monthly on the second Wednesday, at the offices of the various members.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Walter L. Kilby, M.D., 101 W. Read St. Meetings are held the third Tuesday of each month.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—Secretary-Treasurer, E. M. Shebesta, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—Secretary, John P. Medelman, M.D., 572 Lowry Medical Arts Bldg., St. Paul. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, Arthur B. Smith, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—Secretary, Paul C. Schnoebelen, M.D., 462 N. Taylor Ave. Meets on fourth Wednesday of each month except June, July, August, and September, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—Secretary, F. L. Simonds, M.D., 1216 Medical Arts Bldg., Omaha. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society (Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island).—*Secretary,* Hugh F. Hare, M.D., Lahey Clinic, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, H. J. Perlberg, M.D., Trust Co. of New Jersey Bldg., Jersey City. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—Secretary, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Leo Harrington, M.D., 880 Ocean Ave. Meetings held the fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Joseph S. Gianfranceschi, M.D., 610 Niagara St. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Ray Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Maurice Pomeranz, M.D., 1120 Park Ave., New York, N. Y.

Rochester Roentgen-ray Society.—Secretary, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

OHIO

Ohio Radiological Society.—Secretary, J. E. McCarthy, M.D., 707 Race St., Cincinnati. The next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, J. O. Newton, M.D., 13921 Terrace Road, East Cleveland. Meetings at 6:30 P.M. at the Mid-day Club, in the Union Commerce Bldg., on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*Secretary-Treasurer,* Samuel Brown, M.D., 707 Race St. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport. The Society meets annually.

The Philadelphia Roentgen Ray Society.—Secretary, Robert P. Barden, M.D., 3400 Spruce St., Philadelphia. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—Secretary-Treasurer, Reuben G. Alley, M.D., 4800 Friendship Ave., Pittsburgh, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—*Secretary,* A. M. Popma, M.D., 220 North First St., Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston. Meeting in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—Secretary-Treasurer, Herman Klapproth M.D., Sherman.

VIRGINIA

Virginia Radiological Society.—Secretary E. Latané Flanagan, M.D., 215 Medical Arts Bldg., Richmond.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Kenneth J. Holtz, M.D., American Bank Bldg., Seattle. Meetings fourth Monday of each month at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russell F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

CANADA

Canadian Association of Radiologists.—Honorary Secretary-Treasurer, A. D. Irvine, M.D., 540 Tegler Bldg., Edmonton, Alberta.

La Société Canadienne-Française d'Eléctrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Roentgen Findings in Acute Infections of the Mastoid Cells. A. S. Macmillan. Ann. Otol., Rhin. & Laryng. **51:** 718–726, September 1942.

The importance of repeated x-ray study of the mastoids during the course of mastoiditis is emphasized, since this method of examination may be the only one that can be relied upon if chemotherapeutic measures have been employed after the mastoid cells have become involved. Within the first few hours of an acute otitis media, the cells about the antrum show increased density as a result of absorption of air and outpouring of serum. This gradually spreads and involves all of the cells in the mastoid process and the petrous pyramid, and the density increases day by day. From the tenth to the fourteenth day decalcification of the cell walls usually can be demonstrated. It is at this stage that radiographic technic must be accurate to allow comparison of the two sides. The decalcifying process may extend over a period of a week before coalescence of the cell outline is noted. Most of the early change takes place about the antrum; later on the cells of the mastoid process and the petrous pyramid become involved.

It is desirable to have more than one projection of the cells in question. In addition to the lateral view, the author recommends films made in the fronto-occipital projection as a routine procedure. This view shows the periantral region and allows a comparison of the right and left sides on the same film. When infection of the petrous cells is suspected, it is necessary to take several views to show the various parts of the pyramids to best advantage. In addition to the lateral or Law position and the fronto-occipital projection, the author uses the vertex mental position to show the base of the skull and also a projection in which the shadows of the pyramids are shown through the orbits.

The changes in the petrous cells, when infected, closely parallel those of the cells in the mastoid process. Decalcification, however, takes place at a slower rate.

A certain number of patients present themselves at the end of a month or more after the onset of the acute otitis media with abatement of the symptoms except for loss of hearing. At this time roentgen examination may show a complete destruction of the mastoid cells. If the patient has been treated with chemotherapeutic measures, operation invariably reveals the area filled with pus and granulation tissue. If none of the sulfa drugs has been used and there are no clinical symptoms, it is likely that this broken down area is sterile. The condition is potentially dangerous in either case, because, with a new infection, important structures are widely exposed and rapidly developing complications may result. The area may, however, undergo sclerosis with healing. L. W. PAUL, M.D.

Intracranial Arterial Aneurysms in the Carotid Canal: Diagnosis and Treatment. W. E. Dandy. Arch. Surg. **45:** 335–350, September 1942.

Aneurysms of the cranial division of the internal carotid artery may occur in the carotid canal or within the cranium. The only symptomatic difference is that those in the cavernous sinus often produce disturbances of the trigeminal nerve, while those in the intracranial portion do not. Surgical treatment may be employed with small risk for nearly all aneurysms in the canal, while those in the cranium may or may not be curable, depending on the relationship to the circle of Willis.

In a review of 108 arterial aneurysms of the brain it was found that 9 (8.3 per cent) occurred in the carotid canal, one case being bilateral. These with 27 cases from the literature bring the total number of cases to 35, of which 4 were bilateral.

While clinical signs and symptoms are important, none is pathognomonic. Necropsy, operation, angiography, and roentgenography of wires inserted into the aneurysm are the only sure means of diagnosis. Calcifications are suggestive, especially those with whorls; but there is always the possibility that the calcification is due to neoplasm.

Carotid canal aneurysms give three types of syndrome: (1) palsies of the extra-ocular muscles; (2) trigeminal neuralgia with corresponding sensory loss; (3) a combination of the two. Third nerve palsy and pain in the affected eye are equally present in intracranial aneurysms. But if, in addition, trigeminal nerve symptoms in the first or second branches are present, the diagnosis of carotid canal aneurysm is almost absolute. Absence of trigeminal nerve symptoms does not, however, rule out aneurysm. Visual disturbances, which may progress even to blindness of the eye on the affected side, are usual.

While these aneurysms have the same tendency to rupture observed in other aneurysms, the thick dural covering serves to delay this occurrence and thus leads to a longer duration of symptoms. Death may occur from intracranial rupture of the aneurysm. Exophthalmos, papilledema, and, rarely, bruit may be observed. That spontaneous cure by thrombosis occurs is doubtful. The age distribution is fairly even through the decades. Duration of symptoms is variable, but over half the patients had symptoms for more than three years. Angiography, while a brilliant procedure, is risky and not always reliable.

One case with successful operation after preliminary partial ligation of the internal carotid, to allow development of collateral circulation, is recorded. Treatment by ligation of the carotid and clipping of the artery distal to the aneurysm, or by clipping the neck of the sac, is recommended.

Details of the reported cases are tabulated and a bibliography is appended. LEWIS G. JACOBS, M.D.

Hemangiomata Arising in the Bones of the Skull. G. F. Rowbotham. Brit. J. Surg. **30:** 1–8, July 1942.

Hemangiomata arising in bone are extremely rare. Not more than 31 cases in the bones of the skull have been described. The author adds 5 cases, for 4 of which he gives detailed clinical and pathological data. The only available record in the fifth case was a roentgenogram. In each of the 4 cases the lesion was located in the frontal bone. Pain was a feature in 2 cases and in 2 a history of previous trauma was ob-

tained. Roentgen examination in each instance showed a typical circular bony defect with clear-cut margins, enclosing a network of fine bony trabeculae.

The radiological features of hemangiomata vary according to stage of development and the type of bone in which they occur. In the skull there are found localized erosions with clearly defined margins enclosing a fine meshwork of trabeculae which often radiate from the center of the tumor to give the classical sunburst appearance, but may be irregularly disposed. In the long bones hemangiomata appear as cystic swellings enclosing stout trabeculae; they occur especially in diaphyses near the epiphyseal line. In vertebral hemangiomata the bone loses its homogeneous structure and becomes striated in a vertical direction, with alternating bands of rarefaction and increased density. The changes are best seen in the bodies of the vertebrae, but pedicles, laminae and spinous processes may also be affected.

Although in all 4 of the author's cases the tumor was apparently solitary, hemangiomata are commonly multiple. Of the 31 cases previously recorded in the literature 6 were in the frontal bone, 12 in the parietal bone, 4 in the occipital bone, and 2 in the petrous bone. These and other details are presented in a table. The tumor is definitely benign, and metastatic deposits are unknown. MAX CLIMAN, M.D.

THE CHEST

Technical Factors Underlying Miniature Roentgenography of the Chest. Hollis E. Potter. Am. J. Roentgenol. **47:** 71–75, January 1942.

In this paper the author outlines the more recent developments that have made possible successful and practical fluorography. These have been concerned largely with the achievement of increased speed. The chief factors involved are the fluorographic screen, the recording film, and the lens. Each of these is discussed at some length and with technical details for which the original paper should be consulted.

Evaluation of Methods for Mass Survey of the Chest. Arthur C. Christie. Am. J. Roentgenol. **47:** 76–82, January 1942.

Christie discusses the advantages and disadvantages of 4 × 5-inch film and 35-mm. film for mass chest surveys. He prefers the 4 × 5-inch film both to the smaller film and to the roentgenographic paper method, giving the following reasons.

"1. In diagnostic accuracy I find the 4 × 5 in. film the most reliable, the roentgenographic paper next, and the 35 mm. film the least reliable.

"2. For permanent record the 4 × 5 in. film is readily and permanently filed with the person's record without reduction, as is necessary with the roentgenographic paper or 14 × 17 in. film, and without special mounting, which is necessary with the 35 mm. film.

"3. The 4 × 5 in. film is readily examined at any time without special illumination, magnification or projection.

"4. I find the study of the 35 mm. film productive of eyestrain and exceedingly tiring which is not true of the 4 × 5 in. film."

Christie continues: "The most determining factor in my preference for the 4 × 5 in. film method is my conviction that the quality of the film is much superior to that of the other two methods. I rate it in diagnostic accuracy very close to the 14 × 17 in. film. In fact, for minimal lesions I would feel more certain of their detection by means of two 4 × 5 in. films made with a tube shift than I would with a single 14 × 17 in. film of the best quality. I have been greatly impressed by the importance of taking two films of every chest in a survey. Shifting the tube serves to uncover portions of the lungs which may have been obscured by bones or other structures in the first roentgenogram. This also enables one to have the additional advantage of stereoscopy if he desires it."

Roentgenological Report of Chest Examinations Made of Registrants at U. S. Army Induction Station No. 6, Third Corps Area, Baltimore, Maryland, May 1, 1941, to March 31, 1942. H. E. Ashbury, J. G. Whildin, F. T. Rogers. Am. J. Roentgenol. **48:** 347–351, September 1942.

This is a report from an army induction station on 22,054 chests examined between May 1, 1941 and March 31, 1942.

In the earlier part of this period paper films were used. Between September 1941 and March 1942, 4 × 5-inch stereoscopic films were employed, supplemented when necessary by 14 × 17-inch stereoscopic films; 15,924 selectees have been examined by this procedure. Although this method is ideal, a few cases are still missed because the lesion has not progressed to a recognizable stage at the time of the first examination. This difficulty was noted by White in his report on the Australian forces (M. J. Australia **2:** 23, 1941) and led to the adoption in Australia of a method calling for a tuberculin test, complete history, and stomach washing for bacterial study, in addition to photoroentgenography.

In the series here reported 2,551 men with primary tuberculosis and 245 with reinfection tuberculosis were found. Of this group, 294 were rejected (1.3 per cent). Of the men examined with paper films, 1.2 per cent were rejected, while of those examined with the 4 × 5-inch films supplemented by 14 × 17-inch stereoroentgenograms, 1.3 per cent were rejected, which is interpreted as being due to greater efficiency of the latter method.

The primary lesions consisted of healed miliary tuberculosis, excessive calcification, stable or unstable, as evidenced by stippling, soft tissue proliferation, and increase in size or number of the glands and parenchymal lesions. Where instability was the only cause for rejection, a re-examination was advised after six months and if no evidence of change was noted the selectee was accepted. The reinfection group included minimal, moderately advanced, and far advanced lesions.

The authors include a table showing the full results of the survey, including non-tuberculous disease and various chest anomalies. S. M. ATKINS, M.D.

Discussion on Surveys of the Chest with Comments on the 14 by 17 Inch Film As Used in the Canadian Army. G. E. Richards. Am. J. Roentgenol. **47:** 66–70, January 1942.

For chest examinations of recruits for the Canadian Army the single 14 × 17-inch film has been chosen as best meeting the requirements. This choice was

dictated largely by the immediate availability in practically all communities of facilities for this type of examination. Economy and accuracy were also taken into consideration. The author estimates the minimum saving per man excluded from the armed forces for either tuberculosis or established non-tuberculous disease—and *vice versa*, the cost to the country for each unrecognized case—as $4,000 and concludes that the cheapest method, therefore, is the one which is most accurate. He is himself an ardent exponent of the stereoscopic method, and believes if this could be made practical for mass surveys it would offer increased accuracy of diagnosis.

Among 328,325 recruits examined by the use of the single 14 × 17-inch film, 3,076 were rejected for tuberculosis and 1,088 for non-tuberculous pulmonary infections. There are 27 known errors—11 of which are designated as "personal" errors due to faulty interpretation, and therefore presumably avoidable, while 16 were considered inherent in the method and unavoidable. The greatest source of error has been and is likely to continue to be found in the failure to recognize early evidences of non-tuberculous infections. This involves both the type of film available for study and the experience of the roentgenologist in interpretation.

Up to the end of May 1941 there had been 895 men discharged from the Canadian army because of pulmonary tuberculosis. Of these the majority had been taken into the army in the first days of mobilization, before chest survey roentgenograms were routine, or for some other reason did not have chest films on enlistment.

Tuberculosis in the Canadian Army. W. P. Warner. Canad. M. A. J. **47:** 193–196, September 1942.

This survey of tuberculosis in the Canadian army covers rejections for the disease at time of enlistment and cases developing in the army from Sept. 1, 1939, to March 1, 1942.

In the fall of 1939, shortly after mobilization x-ray examination of the chest became a routine procedure for all recruits. Men with small scattered calcified lesions were accepted. Larger lesions, although considered healed, were regarded as too great a risk and were therefore grounds for rejection. Men with a history of idiopathic pleurisy with effusion or idiopathic dry pleurisy within five years before attempted enlistment were also rejected. Of 400,000 men examined roentgenologically, 1 per cent were rejected. Had these men been accepted, the incidence of clinical tuberculosis in the army would be greatly increased, both because of their breakdown under active service and the production of new cases by infection of their fellow soldiers. The effect of detection of these cases on the civilian tuberculosis problem is more difficult to estimate. It is certain, however, that since these men felt well enough to join the army, their condition was not likely to be diagnosed for some time; they would be unlikely to seek medical advice soon and would be a source of infection to others.

X-ray examination was valuable for the detection of tuberculosis in recruits in several ways. First, many recruits, because of their desire to enter the army, would deny the presence of symptoms when questioned by the clinician. Second, a large number of minimal cases, in which a diagnosis is most desirable, were discovered which would otherwise have escaped detection. Only 270 cases out of 1,334 could be diagnosed by clinical findings when the lesion had been shown by x-ray. As the extent of lesions increased, the number of clinical diagnoses also increased. Of men passed without radiographic examination, approximately 1 per cent were discharged for tuberculosis when roentgen studies were made two months later.

In men on active service 114 cases of clinical tuberculosis were known to have developed between Sept. 1, 1939, and March 1, 1942. Ten of these were in men enlisted with active tuberculosis by error before the chest survey was begun. Of the remaining 104, 96 had a negative roentgen examination and 8 showed small lesions on admission but were considered fit for service. Of these cases, 31 were diagnosed as pleurisy with effusion, 20 minimal tuberculosis, 20 moderately advanced tuberculosis, 16 far advanced tuberculosis, 17 non-pulmonary tuberculosis. The average duration of symptoms until these cases were diagnosed and under treatment in the hospital was 2.7 months.

M. L. CONNELLY, M.D.

Miniature Mass Radiography in the RAF. Review of 20,000 Examinations. R. R. Trail. Lancet **1:** 609–610, May 23, 1942.

Miniature mass radiography of the personnel of the British Royal Air Force was begun in November 1941 and up to the time of this report 19,969 subjects had been examined, with the discovery of 54 cases of active and 67 of inactive pulmonary tuberculosis. In these examinations it has been found that in almost all miniature films showing lung abnormalities the contrast has been greater than that seen on the following large film. "This does not imply that every abnormality has been found, nor that passing any individual before an x-ray machine increases his immunity or his resistance to future disease. It does mean that a number of lung abnormalities, including in particular pulmonary tuberculosis, have been discovered in individuals who, up to the time of taking the miniature film, made no complaint of symptoms, and had not been discovered by ordinary routine medical examination."

A comparison of the condenser unit and the more usual English form of valve-rectified equipment is included.

Tuberculosis Case Finding in Institutional Populations. The Use of 35 Mm. Fluorograms Among the Mentally Ill. H. E. Hilleboe, R. B. Haas, C. E. Palmer, and W. P. Gardner. Am. J. Pub. Health. **32:** 516–522, May 1942.

To the increasing number of reports on mass tuberculosis surveys by means of fluorography, the authors add a study of the inmates of the Anoka (Minnesota) State Hospital for mental cases. More than 1,200 subjects were tested and though few could co-operate and many were deformed or were otherwise unfavorable subjects physically, the results were considered excellent. Over 150 cases of tuberculosis were discovered in addition to 66 known previously to exist.

The apparatus consisted of a portable and inexpensive fluorographic unit, using 35-mm. film in a standard camera, and transportable 200-milliampere x-ray equipment. The readings of small films were checked against independent interpretations of corresponding standard x-ray plates, with the result that the errors

of both over- and under-reading were found. In neither respect was the lack of correspondence great enough to cause concern about the essential accuracy of the technic as a screening device, even among uncooperative subjects.

Mass Radioscopy in Factories. Two Small Surveys. A. S. Hall. Lancet **1:** 161–162, Feb. 7, 1942.

Having employed fluoroscopy satisfactorily for chest examination in his private practice, the author conducted surveys in two British factories. He devotes this paper largely to a discussion of the organization of the surveys, which were undertaken without expense to the factory management and on a voluntary basis so far as the employees—mostly women—were concerned. In the first factory only 60 per cent of the employees came for examination, and the author believes this may have been due to an over-use of propaganda and too frequent mention of tuberculosis. In the second factory, in which tuberculosis was not mentioned specifically, there was a 97 per cent response. Of 575 people examined in the first factory, 3 were found to be tuberculous. Of 795 examined at the second factory, 2 were known to have phthisis and 2 others were found to have active disease.

Silicosis and Other Health Problems of Metal Miners. W. C. Dreessen, R. T. Page, and H. P. Brinton. Am. J. Pub. Health **32:** 142–150, February 1942.

This report is based on a study of three representative metal mines in the state of Utah, made in 1939 by the U. S. Public Health Service, in co-operation with the State Board of Health and the State Industrial Commission. Occupational and medical histories and physical and roentgen examinations were made of 783 workers—90 per cent of those engaged in these mines. Engineering studies were also carried out to determine environmental factors which might be of significance in relation to health. The mines chosen for study were underground mines extracting lead-copper or lead-silver ores, in which gold and zinc occasionally occurred in sufficient amounts to be considered as supplementary ores. They were selected to be representative of mining conditions which were cold and wet, hot and dry, and intermediate. Some evidence of lead poisoning was found, but the chief emphasis of the paper is upon silicosis.

The incidence of silicosis was found to be related both to the length of employment in the industry and the average dust concentration to which the worker was exposed. Among 727 persons whose entire experience in a dusty trade had been in metal mines, there were 66 cases of silicosis, 42 first stage and 24 second stage. Among 137 persons who had been exposed to atmospheres with an average dust concentration of less than 10 million particles per cubic foot of air there were only 3 cases (2.2 per cent), and these were in persons who had worked seventeen or more years in metal mines and probably had been exposed to much higher dust concentrations during certain periods in the past. Among 187 persons exposed to an average dust concentration of 24 million particles, on the other hand, there were 32 cases (17 per cent). When years employed in metal mines, as well as dust concentration, are considered, the prevalence of silicosis is greatly increased, reaching 37 per cent among those with twenty or more years' experience in an average dust concentration of 18.0 to 23.9 million particles and 68 per cent of those with twenty or more years' experience in an average dust concentration of 24 million particles and over.

In their conclusions the authors advocate pre-employment and annual medical examinations, including a technically good chest roentgenogram, to detect cases of active pulmonary tuberculosis. These physical examinations enable the physician to discover such common ailments as high blood pressure, nephritis, diabetes, syphilis, and heart disease during their incipient stages and to advise the worker on remedial measures. The annual examinations will also detect early silicosis and thereby call attention to deficiencies in dust control.

Acute Pneumonitis—An Atypical Bronchopneumonia of Virus Origin. J. Markham. J. Canad. M. A. J. **47:** 133–137, August 1942.

This is a discussion of 65 cases of acute respiratory infection observed at Fort Osborne Military Hospital over a period of six months. While this disease entity cannot be clinically classified as influenza or "grippe," the cases nevertheless differ from pneumococcus lobar pneumonia or bronchopneumonia due to *S. haemolyticus* or staphylococcus.

The most significant characteristic is the radiologic appearance of extensive parenchymal changes coupled with a minimum or absence of clinical findings. Patients may be divided into three groups: (1) those who do not feel ill, (2) those with mild symptoms, *i.e.*, headache, malaise, and a dry hacking cough; (3) the acutely ill, with slight cyanosis, dyspnea, and high fever. Malaise was the most common symptom, accompanied by headache and generalized muscular pains. Cough was present in all cases which subsequently showed radiographic findings.

The incidence of the disease was highest in the winter and spring months. Most of the patients in the series reported were men between twenty and thirty years of age. Case studies show the disease to be definitely communicable.

Laboratory findings showed an average white cell count of 10,000, with a slight elevation of polymorphonuclears. The sedimentation rate was usually increased to 25 mm. per hour. Sputum was scanty, and cultures revealed the usual flora found in the respiratory tract in healthy persons.

The average stay in the hospital was twenty-two days, the shortest fourteen days, the longest sixty-five days.

Radiologically, the lesion takes the form of spreading infiltrative change from the hilus toward the periphery of the lung. There is usually a mottled appearance affecting a portion of one lobe or possibly patchy involvement of one or more lobes, involvement of the lower lobes being a little more common.

Observation reveals a complete lack of response to chemotherapy in practically all cases.

The importance of a proper diagnosis, especially among soldiers, is stressed. M. L. CONNELLY, M.D.

Adenoma (Mixed Tumor) of Bronchus: Study of 35 Cases. L. H. Clerf and C. J. Bucher. Ann. Otol., Rhin., and Laryng. **51:** 836–850, September 1942.

The authors report a study of 35 cases diagnosed as adenoma of the bronchus at the Bronchoscopic Clinic

of Jefferson Hospital (Philadelphia) since 1927. This tumor apparently is not so uncommon as earlier reports would indicate. Unlike carcinoma, it is observed frequently among females; in this series 54 per cent of the patients were females. Also, it tends to occur at an earlier age period than carcinoma, 12 of the group being between twenty and thirty years of age. The symptoms were due to bronchial irritation and to obstruction, and the marked vascularity of the tumor often resulted in severe hemoptysis.

Adenoma of the bronchus is a slowly growing tumor, and many of the patients presented symptoms and signs as well as roentgen evidence of pulmonary disease for many years. The physical signs and roentgen findings were dependent upon the degree of obstruction and the extent of the changes distal to the lesion. Because of the slow growth of the tumor, extensive bronchopulmonary changes, including fibrosis and bronchiectasis, were observed. In 15 patients there was atelectasis of one or more lobes of the lung. In 6 there were clinical signs of suppuration with atelectasis in addition. In 4 there were evidences of obstructive emphysema and in 3 the growth was demonstrable roentgenologically as a sharply circumscribed mass. Initial bronchoscopy revealed a preponderance of left-sided lesions, 21 being found on this side. No explanation is offered for the frequency of left-sided involvement.

In only one case in this series did cancer of the lung develop, and the impression that adenoma does not become malignant is also implied in the literature.

Ordinary roentgen studies of the chest commonly fail to give information concerning the extrabronchial portion of the tumor, owing to atelectasis or chronic pulmonary changes incident to suppuration. The recent development of tomography has aided greatly in securing information concerning the relation of the tumor to the bronchus, and, in spite of extensive pulmonary changes, it is now possible to demonstrate the presence of an extrabronchial mass, indicating that the tumor is not limited to the bronchus. The additional diagnostic data thus obtained will influence the plan of therapy to be instituted.

By bronchoscopic removal of the endobronchial portion, one can usually re-establish drainage of the lung distal to the growth. If the evidence is conclusive that the growth is entirely endobronchial, bronchoscopic removal and electrocoagulation may be sufficient to re-establish and maintain an adequate bronchial lumen. The common co-existence of extrabronchial tumor, however, renders the method inadequate as a curative measure in most instances. Surgical extirpation is indicated in cases not accessible to bronchoscopic treatment and in those with chronic pulmonary changes distal to the tumor, as well as in the cases of extrabronchial tumor. L. W. PAUL, M.D.

Observations Concerning Pulmonary Fibrosis in Raynaud's Disease. Report of Two Additional Cases H. Linenthal. New England J. Med. **227:** 433–436 Sept. 17, 1942.

Pulmonary fibrosis occurs in patients with Raynaud's disease. The course of the disease is typical, with development of scleroderma. Some time later dyspnea develops, and chest films at this time show evidence of fibrosis at the bases.

Two complete case reports are here presented. In one patient, still living, an extensive study of pulmonary dynamics has been made, showing total lung volume, 2,495 c.c.; vital capacity, 795 c.c.; complemental air, 595 c.c.; reserve air, 200 c.c.; midcapacity, 1,900 c.c.; residual air, 1,700 c.c. The chest film showed diminished radiance at the left base, with flattening and limitation of the left diaphragm. These changes are typical of Raynaud's disease.

The second patient had Raynaud's disease for ten years. She had been digitalized for cardiac decompensation. A chest film showed an enlarged heart and exaggerated markings at the bases of both lungs. At autopsy the heart was found to be enlarged, with dilatation and hypertrophy of both auricles. The lower parts of both lungs were compressed by pleural fluid. The pulmonary veins and arteries were moderately dilated. There was fibrous thickening of the pleura and pulmonary tissue. Some of the bronchi and bronchioles showed fibrosis. The alveolar spaces were relatively normal but slightly reduced in size. The alveolar walls were thickened and prominent, with an increase in fibrous tissue up to ten to fifteen times normal. The alveolar spaces showed no evidence of inflammatory reaction. The thickening of the alveolar walls resulted in partial obliteration of the spaces so that many areas appeared to be atelectatic. In some places, thick buds of cells, with indefinite outlines and fibrous stroma, projected from the alveoli into the spaces. The capillaries were dilated and congested and many were thicker than normal. The pathological diagnoses were enlarged heart, congestive heart failure, and diffuse pulmonary fibrosis.

JOHN B. MCANENY, M.D.

Role of the Roentgenologist in the Diagnosis of Congenital Cardiac Lesions. R. S. Bromer. J. A. M. A. **120:** 251–254, Sept. 26, 1942.

Accurate diagnosis of congenital heart lesions is dependent on complete clinical as well as roentgenologic findings. A knowledge of the normal roentgenographic image of the heart, not only in the anteroposterior but also in the oblique and lateral projections, is most essential. The majority of congenital heart lesions are most difficult to diagnose. The difficulties encountered in examinations in infants and children are obvious.

Abbott's classification of congenital heart lesions is the one usually quoted. It recognizes three groups:

1. Acyanotic Group: This consists of cases in which no abnormal communication exists between the venous and arterial streams but in which mechanical interference with the circulation caused by the anomaly makes this the seat or point of cardiac strain. Included in this category are left-sided valvular stenoses or insufficiencies, anomalies of semilunar or auriculoventricular cusps, coarctation and hypoplasia of the aorta, primary congenital hypertrophy, congenital rhabdomyoma, percardial defect, anomalous septa, ectopia cordis abdominalis, congenital arteriovenous aneurysms, and anomalies of the aortic arch and its branches, of the pulmonary artery, and of the great venous trunks.

2. Cyanosis Tardive: In this group there is arteriovenous shunt with possible temporary or late reversal of flow, while cyanosis is absent except as a transient or terminal phenomenon. These lesions are localized uncomplicated defects of the interauricular, inter-

ventricular, or aortic septa, patent foramen ovale, and ductus arteriosus.

3. Cyanotic Group: This comprises cases of permanent venous-arterial shunt and right-sided valvular lesions, with or without septal defects.

The mere enumeration of these lesions emphasizes the necessity of close collaboration between the roentgenologist and the clinician. In large interauricular septal defects, Ash found that an increased width of the cardiac shadow to the right of the sternum in the anteroposterior view is most often caused by an enlarged right atrium which gives rise to the appearance of a globular heart situated in the mid-position. Enlargement of the low arc, left border of the heart, is not infrequently caused solely by hypertrophy of the right ventricle. Atrophy of the left ventricle may be shown by flattening of the posterior outline of the heart with increase in the clear space between the heart and the chest wall.

The roentgenographic features of the more usual cardiac defects of which a diagnosis is possible in infancy are as follows (none of these can, however, be regarded as pathognomonic or as permitting, of itself, a definite diagnosis):

Intraventricular Septal Defect (maladie de Roger): The roentgen contour of the heart is usually unchanged. There may be hypertrophy of both the right and left ventricles, seen sometimes in the lateral and oblique views.

Interauricular Septal Defect: Ash found the globular shaped heart was more characteristic in infants than the left-sided preponderance of the cardiac shadow described by Abbott.

Pulmonic Stenosis: In this condition the fluoroscope is especially valuable, as the hilar areas should be small in pulmonic stenosis, while in patent ductus arteriosus, which may be confused with it clinically, prominent pulsating shadows are often noted.

Tetralogy of Fallot: Lateral and oblique projections will demonstrate the enlargement of the right ventricle, and the mediastinal shadow is often enlarged to the right side. If the hypertrophy of the right ventricle is sufficiently well defined, the lower pole of the cardiac apex is formed by the right ventricle, the left being displaced upward.

Complete Transposition of the Great Vessels: This lesion may be associated with either a large right ventricle or a large left ventricle.

Patent Ductus Arteriosus: Because of possible relief of symptoms of this lesion by operative procedure, there is now even greater necessity for painstaking and careful study to arrive at a correct preoperative diagnosis. The heart is sometimes normal in size or may show slight generalized enlargement. Because of the shunt, increased pressure is exerted in the pulmonary artery and its branches. If this is sufficiently great, it will cause these vessels to undergo various degrees of dilatation.

Teleroentgenograms in the erect position are the most valuable. Fluoroscopic examinations in company with the referring cardiologist or pediatrician are most desirable. The roentgenologist should attend postmortem examinations in all cardiac cases and should see the heart *in situ* on the autopsy table and should correlate its appearance and the size and shape of the chambers with his roentgenographic findings.

CLARENCE E. WEAVER, M.D.

Changes in the Size of the Heart in Children with Rheumatic Fever. J. D. Keith and Miriam Brick. Am. Heart J. **24:** 289–314, September 1942.

Repeated roentgen studies of the heart during a single attack of rheumatic fever were made in 100 children, with from 2 to 12 roentgenograms in each case. In 33 cases the heart became larger, in 18 it was unchanged, and in 49 it became smaller.

The authors reach the following conclusions:

"Acute dilatation, with a dramatic change in the size of the heart, does not seem to occur (except under rare circumstances).

"A moderate initial increase in the size of the heart can take place within two or three weeks, but enlargement appears to occur slowly at any stage of the disease.

"A fairly marked increase in the size of the heart may occur in five or six months, but the average change in this time is not great.

"A notable decrease in size may occur in five months, but the usual change in this interval is not great.

"When change in size in one month is more than 20 sq. cm. in the cardiac surface area, pericarditis is probably present.

"The prognosis is obviously better, on the whole, if the heart is getting smaller, rather than larger.

"The heart muscle shows greater recuperative powers than the heart valves. Improvement is more striking in the muscle than in the valve.

"Roentgenologic examination aids in differentiating between myocardial and valvular disease.

"In most cases the progress of a patient can be estimated better by studying the size of the heart than by studying the murmur.

"Bradycardia is more likely to produce cardiac enlargement than tachycardia (certain cases of paroxysmal tachycardia excepted).

"Continued rest in bed reduces the size of the heart when no disease is present."

WM. H. GILLENTINE, M.D.

Unusual Site of an Aneurysm of the Aorta. W. Dressler. Am. Heart J. **24:** 417–422, September 1942.

The author presents a case of syphilitic aneurysm of the aorta notable for its occurrence in the left side of the aorta and for unusual pressure symptoms. The only roentgenologic study, an orthodiagram, showed an irregular pear-shaped mass with sharp outlines adherent to the left border of the heart. The aorta appeared dilated but it could be differentiated from the abnormal mass at the left of the silhouette. The trachea was deviated to the right.

WM. H. GILLENTINE, M.D.

Further Data about the Circulation and about the Cardio-Vascular System Before and Just After Birth. A. E. Barclay, K. J. Franklin, and M. M. L. Prichard. Brit. J. Radiol. **15:** 249–256, September 1942.

This is a report of further studies of the circulation and the anatomy of the cardiovascular system of newborn lambs delivered by cesarean section (see, for example Brit. J. Radiol. **15:** 66, 1942. Abst. in Radiology **39:** 370, 1942). This study has to do with various positions for examination, comparison of the circulation and anatomy of premature with mature fetuses, and the circulation of the liver in the

fetus. The circulation studies are made by injecting the newborn fetus, under suitable anesthesia, with opaque solution and recording the observations by cineradiography.

The studies made in the lateral position are in general more informative. Some were made in the dorsal position better to show the division of the circulatory stream, and to provide further information about the liver.

The circulation in fetuses of 100 days (full term 147 days) is very similar to that of the mature fetus.

Comparison of the anatomical features of the premature fetus with the mature reveals interesting information regarding the liver. In the early fetus the liver furnishes a large part of the body weight, becoming progressively less in proportion from the 69th day onward, at the same time moving to the right side of the body. In the mature fetus the liver is about 70 per cent supplied by the umbilical vein; the remainder by the portal vein. There is evidence to indicate that the umbilical vessels are particularly contractile at the level of the umbilicus.

In two fetuses, the ductus venosus became functionally closed within twenty-five minutes after ligation of the umbilical cord. SYDNEY J. HAWLEY, M.D.

THE DIGESTIVE TRACT

Obstructions of the Second and Third Portions of the Duodenum. M. M. Zinninger. Surgery 12: 393–406, September 1942.

The author reports his experience with 5 cases of obstruction of the second and third portions of the duodenum. In most such cases the diagnosis depends upon the skill and ability of the roentgenologist and it is suggested that many cases of partial obstruction are overlooked because of incomplete or inadequate roentgenologic study or improper interpretation.

Case 1: A white male, 75 years of age, had sudden onset of persistent vomiting five days before admission. After decompression of the stomach a small amount of barium was given by mouth, which apparently met a complete obstruction at the duodenojejunal junction. At operation adhesions were found between the jejunum and the mesentery of the midileum, which had produced a torsion of approximately 180 degrees in the mesentery and so twisted the jejunum as to produce a complete occlusion at Treitz's ligament.

Case 2: A white female, 32 years of age, complained of loss of weight and persistent vomiting. She had had many previous operations—for acute appendicitis, for hemorrhoids and rectal fissure, a hysterectomy and finally a cholecystectomy. X-ray examination showed a sac-like dilatation of the duodenum. Fluoroscopically barium could be followed to the junction of the second and third portions. Reverse peristalsis then occurred and most of the material was regurgitated into the stomach. At operation the first and second portions of the duodenum were found to be dilated, the third portion contracted. Partial obstruction was due to the pull of the superior mesenteric vessels compressing the duodenum against the vertebral column. An antiperistaltic duodenojejunostomy was done and the patient ceased vomiting and gained weight.

Case 3: A white male, age 30 years, was admitted to the hospital because of hematemesis and abdominal pain. Pain was of one week's duration and vomiting began two days before admission. X-ray examination showed a dilated, atonic stomach with a deformed duodenal cap and a large ulcer niche in the central portion. The duodenum was dilated in the first, second, and third portions and presented active forward and reverse peristalsis. Abrupt narrowing of the caliber of the duodenum occurred at about the mid-point of the transverse portion. In the erect position no barium passed but with the patient recumbent a small amount passed, at intervals. There was no twenty-four hour retention. At operation, a large duodenal ulcer with considerable scarring was found. Though the pylorus was patent, the stomach was greatly distended. There was a marked obstruction of the transverse portion of the duodenum where the mesenteric vessels passed over it. Two-thirds of the stomach was resected and a posterior Polya anastomosis was done. Because of the duodenal constriction a duodenojejunostomy was done to allow the bile and pancreatic juice free access to the jejunum. The postoperative course was smooth and the patient gained weight.

Case 4: A white male, age 26 years, was admitted to the hospital complaining of weakness, loss of weight, and vomiting, with symptoms of about ten months' duration. X-ray examination showed a normal esophagus with moderately dilated stomach filled with fluid. Barium could be expressed through the pylorus manually. The duodenal bulb and part of the third portion of the duodenum were tremendously dilated. Barium was not seen to progress at one, two, and four hours. At operation, marked dilatation of the duodenum was found up to the point where the mesenteric vessels crossed the transverse portion. In addition, a peculiar constriction of the first 18 to 20 inches of the jejunum, with marked thickening of the wall, was observed. The mesenteric glands to this segment of the bowel were greatly enlarged. The involvement of the bowel suggested a regional jejunitis and resection was considered too hazardous for the patient in his depleted state. Accordingly an antiperistaltic duodenojejunostomy was done between the dilated part of the duodenum and the jejunum distal to the involved bowel.

Case 5: A white male, 47 years of age, was admitted to the hospital complaining of nervousness, weakness, insomnia, and pain in the back and abdomen. Two years previously he had had an attack of hematemesis and tarry stools. Recent x-ray studies showed deformity of the duodenal cap suggesting ulcer, with a small diverticulum of the stomach on the lesser curvature near the cardia. A laparotomy was done. The diverticulum of the stomach could not be located and there was no active duodenal ulcer, though a small scar was present. The head and body of the pancreas were firmer than normal. The appendix was removed. The postoperative convalescence was smooth, the patient was discharged apparently well. Approximately a month later he was readmitted because of recurrence of symptoms. The small bowel was examined by means of barium instillation through a duodenal tube. This showed a slight constriction and an irregular cavity about 1.5 cm. in diameter in the third portion of the duodenum. At a second operation an annular mass was found constricting the third portion of the duodenum. This was excised and found to be an adenocarcinoma. Some of the preaortic lymph nodes showed metastases. Nine months later the patient was apparently well. J. E. WHITELEATHER, M.D.

Ileus Associated with Edema of the Bowel. O. C. Leigh, Jr. Surg., Gynec. & Obst. **75:** 279–284, September 1942.

Attention is called to a group of cases of paralytic ileus associated with edema of the bowel, observed during the process of intubation with the Miller-Abbott tube. In 17 such cases an average of 6.2 days was required to advance the tube along the length of the small bowel, in contrast to an average of only 2.1 days in 26 cases of ileus due to operative trauma. The tip of the tube passes the pylorus without difficulty, but after the balloon is inflated progress is slow, the excess tubing accumulates in the stomach, and the extra loops prolapse into the duodenum.

It is the author's opinion that the edema results from lowered plasma protein concentration and is exaggerated by intravenous saline infusion. Therapy which raises the lowered plasma protein level restores small bowel activity and aids in deflation. The only other causes of true inhibition of the bowel activity are lesions of the spinal cord or the retroperitoneal space. Ileus associated with operative trauma is probably the result of mechanical obstruction caused by delicate adhesions which disappear during deflation. There is no actual inhibition of intestinal activity in these cases, as in those with edema.

Two illustrative cases and some inconclusive experimental work are presented. No attempt is made to explain or discuss the factors responsible for the gaseous distention in cases of ileus.

IVAN J. MILLER, M.D.

Intussusception in Adults. P. G. Rowe. Canad. M. A. J. **47:** 219–225, September 1942.

Intussusception is essentially a disease of infancy and early childhood, only 5 to 10 per cent of cases occurring in adults. This is a presentation of 10 hitherto unreported cases in adults treated at Montreal General Hospital in the past ten years.

Intussusceptions are usually divided, etiologically, into two classes: primary, in which no gross causative lesion is found, and secondary, in which a primary lesion can be demonstrated as the cause of the intussusception. The majority of adult cases are secondary. The most common cause is a tumor of the intestine, usually benign if located in the small bowel, more often malignant if in the large bowel. Meckel's diverticulum follows tumors of the bowel as a causative agent. Disease of the appendix and a number of other rare causes are also mentioned.

Most intussusceptions are of descending type but retrograde or ascending intussusception can and does occur. In the descending type there is increased normal peristalsis, while in the retrograde type there is forcible reversed peristalsis. Retrograde intussusception is relatively infrequent; in three series of cases of intussusception the incidence was 8 cases out of 593, 3 cases out of 154, and 6 out of 1,000.

Clinically, intussusception may be acute, chronic, or recurrent. Although occasionally found in adults, 95 per cent of acute cases are encountered in children, the onset being sudden, characterized by severe, cramp-like abdominal pain, usually followed by vomiting. The attacks last a few minutes and recur every ten or fifteen minutes. Blood is found in stools within twenty-four hours in 90 per cent of cases. In 84 per cent a mass can be felt. Acute intussusception should be regarded as a surgical emergency.

Chronic intussusception occurs chiefly in adults. Throughout most of the course it is unattended by evidence of intestinal obstruction. Typical symptoms are onset of sudden colicky abdominal pain lasting a few minutes, followed by relief for ten to fifteen minutes. Constipation or diarrhea is frequently present. There is usually a loss of weight due to pain, sleeplessness, and the fact that the patient does not take much food, as eating aggravates his discomfort. A mass may be palpable.

X-ray examination following a barium enema may be helpful, a significant finding being a cupola effect in the head of the barium as it meets the intussusceptum and a thin cylinder of barium around the intussusceptum.

An intussusception may reduce itself spontaneously and then recur at a later date, this type being known as recurrent intussusception.

The 10 reported cases may be briefly classified as follows: 2 acute and 8 chronic; 8 direct and 2 of retrograde type. The ileum was the most common site, being involved in 5 cases. The jejunum was involved in one case; there were 2 cases of ileocolic intussusception and 2 of intussusception of the sigmoid into the rectum. Two cases were of primary type and 8 of secondary type. The primary lesions in the cases of secondary type were: Meckel's diverticulum in 2 or possibly 3 cases, appendicular disease in one case, a mesenteric gland in one case, and tumors of the bowel in 2, one a carcinoid tumor of the small bowel and the other a carcinoma of the sigmoid. One case was secondary to a pre-existing gastro-enterostomy.

MARIE L. CONNELLY, M.D.

SUBPHRENIC ABSCESS

Subphrenic Abscess. R. K. Magee. Canad. M. A. J. **47:** 213–218, September 1942.

Subphrenic abscess occurs most frequently in males; it is right-sided in 75 per cent of cases, and is most often a result of an intraperitoneal suppurative lesion. The organisms most frequently encountered are *B. coli* (40 per cent), streptococcus (25 per cent), and staphylococcus (20 per cent). The usual picture is that of fever and leukocytosis with continuing evidence of a suppurative process. Pain is the most important symptom for localization of the lesion. Signs are more frequent in the chest than in the abdomen. Among these are diminished movement on one side, impaired resonance over the lower chest, decreased breath sounds, and friction rub and râles just above the area of dullness. The most important sign is tenderness along the twelfth rib behind or along the costal margin in front. The condition is undiagnosed in about one-third of the cases due to failure to suspect its presence.

Roentgenographic examination is helpful, with the fluoroscope to study movement and with a film to determine the position of the diaphragm. The latter is elevated and fixed or its movement is diminished in about 70 per cent of cases. Films should be taken in the anteroposterior and lateral directions with the patient supine and upright. Subphrenic abscess is ruled out when air injected into the peritoneal cavity rises to the area under the diaphragm with the patient erect; also when barium in the stomach rises to lie immediately beneath the dome of the left diaphragm with the patient in the Trendelenburg position.

The majority of complications occur in the chest.

Pleural effusion is present in about 30 per cent of the cases. Rupture of the abscess may result in pneumonia, lung abscess, mediastinitis, etc.

Preventive measures include care to avoid soiling at operation and provision for drainage in all suppurative lesions. Conservative treatment, with transfusions, forced fluids, and chemotherapy is justifiable for a few days, as it is believed one-fifth to two-thirds of cases of subphrenic inflammation resolve without suppuration. No longer than one week should be allowed, however, for infection to subside. Once suppuration has occurred, immediate operation is indicated. The object is to secure drainage without spreading the infection into pleura or peritoneum. A method of extra-serous drainage in which the peritoneum is stripped off the under surface of the diaphragm is the procedure of choice.

The mortality in cases without operation is 90 to 100 per cent. In the past, with the trans-serous approach the mortality has been 35 to 50 per cent. With early drainage and the extra-serous method presented here, it has been consistently maintained at 6 to 10 per cent.

Two cases are presented which demonstrate the dangers of delay and also the complete cure which may be achieved by perseverance.

M. L. CONNELLY, M.D.

THE SKELETAL SYSTEM

Time of Appearance and Fusion of Ossification Centers as Observed by Roentgenographic Methods. H. Flecker. Am. J. Roentgenol. **47:** 97–159, January 1942.

Only the most general indication of the scope of the study presented in this comprehensive paper can be given. The author observed roentgenologically a series of hospital patients and, in addition, some 50 fetuses (30 to 334 mm.), in an attempt to determine the time of appearance and fusion of the ossification centers. The following points with regard to each sex were noted: (*a*) ages of youngest subjects in whom ossific centers in question were found to be present; (*b*) ages at which in at least half of the subjects centers were found to be present; (*c*) ages of oldest subjects in whom epiphyses were found to be fused with the diaphyses; (*d*) ages of youngest subjects in whom epiphyses were found to be fused with diaphyses; (*e*) ages at which in at least half of the individuals epiphyses were found to be fused; (*f*) ages of oldest subjects in whom epiphyses were found to be fused with diaphyses.

The various parts of the skeleton are considered separately and the findings of other observers are quoted for comparison. Numerous illustrations and tables are included. One of the latter is a summary of the study in chronological order from the nine-week fetus to the age of twenty-one years.

Acute Fulminating Osteomyelitis of the Frontal Bone: A Review and a Prediction. G. B. Fred. Ann. Otol., Rhin. and Laryng. **51:** 638–647, September 1942.

Forty cases of acute fulminating osteomyelitis of the frontal bone occurring during the past ten years have been reviewed by the author. This is a virulent infection which complicates acute frontal sinusitis and spreads rapidly to the adjacent bone. It frequently follows swimming and diving and very often is fatal, usually terminating in brain abscess or meningitis. The etiological organism is usually *Staphylococcus aureus*. Two clinical types are recognized: (1) the fulminating and (2) the localizing type. The latter is less virulent and tends to become localized and form sequestra.

One of the cardinal principles in diagnosis of this condition is that pitting doughy edema of the forehead is the first and most reliable sign. It precedes x-ray evidence by at least a week or ten days and is due to the thickening or separation of the periosteum from the frontal bone. When such edema is present, it is not necessary to wait for positive x-ray evidence, since it is considered pathognomonic. When positive x-ray evidence appears, it indicates gross destruction of bone. This takes time and gives the disease an opportunity to spread and cause further complications. One-half of the author's 40 cases had no x-ray evidence of osteomyelitis on admission. Osteomyelitis of the frontal bone was noted in 14 cases; involvement of the anterior wall of the frontal sinus was present in 4; and in 2 cases the x-ray films were lost. Eleven of the 20 cases originally negative for osteomyelitis finally showed evidence of bone infection while 9 never became positive at any time due to the early removal of the osteomyelitic bone when pitting edema of the forehead was present.

The surgical treatment of the disease is discussed in some detail, and the author is impressed with the necessity for early removal of the infected bone when the clinical signs and symptoms are definite. He is also of the opinion that chemotherapy will in the future modify and perhaps even revolutionize the treatment of osteomyelitis. The greatest use for the sulfa drugs will probably be in the prevention of the disease, provided they are used early and in adequate doses. These drugs plus incision and drainage through the floor of the frontal sinus, if instituted early enough, may prevent the spread of infection to the frontal bone.

L. W. PAUL, M.D.

Rheumatoid Arthritis Associated with Splenomegaly and Leukopenia. R. H. Talkov, W. Bauer, and C. L. Short. New England J. Med. **227:** 395–399, Sept. 10, 1942.

Rheumatoid arthritis accompanied by leukopenia and splenomegaly has been known as Falty's syndrome. Five cases of this combination are reported and evidence is presented to show that these findings are not necessarily related, that rheumatoid arthritis may be associated with leukopenia, and that splenomegaly may arise from some other cause. Several cases from the literature are critically reviewed and it is pointed out that some of the cases were not sufficiently investigated, while in others the findings may be attributed to some other evident cause. In a review of 293 cases of rheumatoid arthritis, splenomegaly was observed in 7 per cent, lymphadenopathy in 31 per cent, and leukopenia in 1 per cent.

The evidence compiled in this critical study leads to the conclusion that the combination of rheumatoid arthritis, splenomegaly, and leukopenia need not be considered a new pathologic entity. It is true that the triad is rare. The conditions that must be considered as possible causes of splenomegaly and leuko-

penia in the presence of rheumatic arthritis are chronic liver disease, pernicious anemia, leukemia, granulocytopenia, hemolytic anemia, amyloid disease, malignant lymphoma, various acute and chronic infections, lupus erythematosus disseminatus, dermatomyositis, and periarteritis nodosa.

It is the feeling of the authors that the term "Falty's syndrome," as descriptive of a pathologic entity, should be abandoned and replaced by the more descriptive designation, rheumatoid arthritis with splenomegaly and leukopenia. It is believed to be more important to realize that rheumatoid arthritis is a generalized disease that may affect lymph nodes, spleen, bone marrow, and other tissues.

JOHN B. MCANENY, M.D.

Morbid Anatomy of a Case of Recurrent Dislocation of the Shoulder. A. L. Eyre-Brook. Brit. J. Surg. **30:** 32–37, July 1942.

The author gives an excellent description of the anatomy of the shoulder joint with numerous illustrations. Among these is a roentgenogram of a normal shoulder joint injected with lipiodol showing that the capsule is attached to the anterior lip of the glenoid cavity and not to the neck of the scapula. In 21 shoulders dissected to demonstrate this region the author was impressed by the strength and size of the superior and inferior gleno-humeral ligaments in post-mortem specimens. In the case of recurrent dislocation which he records, with necropsy findings, there was a detachment of the anterior capsule and glenoid labrum from the lip of the glenoid. The head of the humerus had a large notch in the posterior surface which appeared to be adapted to the flattened anterior rim of the glenoid cavity. This notch was believed to be the result of erosion and absorption from intermittent pressure. The development of the notch and the absorption of the anterior lip of the glenoid account for the increasing frequency and ease of dislocation which is characteristic of cases such as the one recorded. A roentgenogram of the shoulder taken from above, with the arm in the coronal plane and in mid-rotation, should be made in all cases of recurrent dislocation in order to demonstrate the notch in the head of the humerus.

MAX CLIMAN, M.D.

Traumatic Displacement of the Lower Radial Epiphysis. D. Sloane. Arch. Pediat. **59:** 594–596 September 1942.

The lower radial epiphysis first makes its appearance at the age of two. Union with the radial shaft takes place at about twenty years of age. At any time before this, traumatic separation is possible. This involves two considerations: first, treatment of the acute disorder; second, the matter of dealing with future growth and deformity problems.

A case is presented in which the typical injury was cared for by a good reduction of the displaced epiphysis; a three-year follow-up showed full return of painless wrist motion.

The author refers to the work of Aitken at the Boston City Hospital (see J. Bone & Joint Surg. **17:** 302, 922, 1935) and quotes Aitken's conclusions.

1. *Regardless of the amount of displacement remaining after reduction, the epiphysis and shaft regain their original alignment after a relatively short interval.* [The italics are the abstractor's.]
2. Shortening is negligible
3. When deformity does occur it is the result of direct injury to the epiphysis.

PERCY J. DELANO, M.D.

Fatigue Fracture of the Tibia. J. Blair Hartley. Brit. J. Surg. **30:** 9-14, July 1942.

The author has observed 14 cases of fatigue fracture of the tibia (called, also, pseudofracture of the tibia) since 1931. The average age in his series is thirteen years; in a series of 12 cases reported by Roberts and Vogt (J. Bone & Joint Surg. **21:** 891, 1939) it was 10.9 years. Generally there is no history of injury and the only clinical feature is pain either behind the knee, in the calf, or over the inner aspect of the upper third of the tibia. The period from onset of symptoms to radiographic examination in the present series was from 10 to 21 days. Radiologically the site of the lesions is seen to be at the upper end of the shaft of the tibia 1 1/2 to 3 3/4 inches below the epiphyseal line, depending on the age and height of patient. In 3 cases the lesion was bilateral. There is always callus, usually on the inner aspect. In early cases a small nick in the bone cortex will be observed medially or laterally and the callus is visible posteriorly. Later an area of osteoporosis will develop at the site of the fracture and in mild cases an ill-defined zone of osteosclerosis. With immobilization the callus increases and the osteoporosis is replaced by dense bone with gradual repair.

Three case reports are included, one of a soldier who had a spontaneous bilateral fracture apparently brought on by prolonged periods of marching. The second case was in a boy of 18 who had a persistent area of rarefaction which did not heal. Operation was resorted to with removal of a small piece of bone and histological examination failed to reveal any etiological factors. This case, the first to be seen by the author, was diagnosed as a localized osteitis of unknown origin. The third patient had a typical fatigue fracture which went on to spontaneous healing after two months. There was no history of injury in this case.

The differential diagnosis lies between simple fracture, osteomyelitis, and early sarcoma.

It is the author's belief that fatigue fractures are due either to a faulty crystal structure of bone at an area of maximum strain, or to abnormal strain at a site already subject to considerable stress. There is a definite similarity to march fracture of the metatarsals both in radiological appearance and in the rate and mode of healing. It is pointed out that, in view of the liability of the younger age groups for war service, the incidence of these fractures is likely to increase, since fatigue fracture is more common in adolescence.

MAX CLIMAN, M.D.

Traumatic and Spontaneous Fractures in Exophthalmic Goiter. F. A. Bothe, H. M. Simpson, and L. G. Rowntree. Surg., Gynec. & Obst. **75:** 357–360, September 1942.

Spontaneous fracture associated with exophthalmic goiter is rare. Seven cases have been reported to date. In most cases the hyperthyroidism has been severe, protracted, and accompanied by extreme decalcification of the skeleton.

There is an increase in the excretion of calcium and phosphates in clinical hyperthyroidism. Also there is an elevation of the serum phosphatase. Authors are not in agreement as to the cause of this calcium

excretion and the demineralization of the skeleton. Pain is an outstanding feature associated with these changes in the bones. Recalcification after treatment is extremely slow.

A case is presented in which the patient suffered both traumatic and spontaneous fractures of the spine. These occurred subsequent to thyroidectomy along with recurrent symptoms of hyperthyroidism. Reoperation with the removal of adenomatous tissue produced recovery from symptoms and slow improvement of the calcium content of the bones.

IVAN J. MILLER, M.D.

Chip Fractures of the Os Triquetrum (Carpal Cuneiform). T. J. Fairbank. Brit. M. J. **2:** 310–311, Sept. 12, 1942.

This rather short article is a timely discussion of fractures of the cuneiform bone of the wrist such as are frequently overlooked. The statement is made that in a series of 86 carefully studied wrist injuries these fractures were much more common than previously supposed, numbering 11. In these cases there were no other associated injuries.

The fracture is usually the result of a fall backward, as in the case of most wrist fractures. The x-ray appearances merit the conclusion that the cuneiform may break at any point; usually the fracture is described as a chip, due to crushing of the os triquetrum against the lower end of the ulna. The condition is best seen in lateral and oblique roentgenograms. Treatment is symptomatic, no special reduction being indicated. Complete recovery occurs in seven to ten weeks and in most cases union is complete.

Q. B. CORAY, M.D.

Non-Osteogenic Fibroma of Bone. H. L. Jaffe and L. Lichtenstein. Am. J. Path. **18:** 205–215, March 1942.

Non-osteogenic fibroma of bone the authors describe as a benign marrow-connective-tissue tumor in which the basic tissue does not undergo osseous metaplasia. Its usual site is the shaft of a long bone (generally one of a lower extremity) not far from an epiphyseal cartilage plate, and the lesion does not necessarily involve the bone in its entire diameter. It is found on histologic study to consist of whorled bundles of spindle-shaped connective-tissue cells loosely interspersed with small multinuclear giant cells, but in many places within a lesion collections of foam cells may be seen, along with other variations in detail.

These lesions have in the past been variously interpreted as "giant-cell variant of bone cyst or osteitis fibrosa," "healing variant of giant-cell tumor," "xanthic variant of giant-cell tumor," "solitary xanthoma or xanthogranuloma of bone" (usually implying a limited expression of Hand-Schüller-Christian's disease), and "fibrous osteomyelitis." The authors believe, however, that such interpretations are erroneous and that the tumor constitutes a distinct entity. Their report is based on 10 cases, all of which occurred in older children or adolescents, the age range being from six to twenty-one years. The clinical findings are not striking and roentgen studies are necessary for even a presumptive diagnosis. Roentgenographically the lesion may appear as a sharply delimited, eccentric, somewhat loculated area of rarefaction, hugging and even bulging out the cortex on one side, or as a multilocular area of rarefaction traversing the bone and perhaps bulging it out on both sides. Treatment by curettement or subperiosteal resection gives entirely satisfactory results.

Primary Adamantinoma of the Ulna. C. E. Anderson and J. B. deC. M. Saunders. Surg., Gynec. & Obst. **75:** 351–356, September 1942.

A case of primary adamantinoma of the ulna is presented. All previously reported cases of this tumor in long bones have involved the tibia.

Pathologically the gross appearance of the tumor is that of a soft, gray, spongy, vascular mass occupying the central portion of the shaft of the bone, expanding it, but not breaking through the cortex. Microscopically it is an infiltrating tumor composed of epithelial elements which may resemble either squamous or enamel epithelium. The stroma is made up of fibrous tissue of varying degrees of density. Multinucleated giant cells are frequently seen and may represent osteoclasts. Inflammatory elements are sometimes present.

Clinically the tumor is of limited malignancy; it does not metastasize nor invade adjacent tissues but does erode bone. Incomplete removal is followed by recurrence. Adult males and females are affected and the tumor is slow growing. All patients give a definite history of trauma and the usual presenting symptom is the presence of a mass. Tenderness, local heat, and fluctuation may be present.

The roentgen appearance is that of an expanding type of tumor with sharp outlines and a fine trabecular pattern. No periosteal reaction is visible nor are there any eroded margins. A fine honeycomb appearance is often seen. The differential diagnosis is difficult, particularly due to the rarity of the tumor.

The case presented is felt to fulfill the criteria for a diagnosis of adamantinoma. The patient gave a history of fractures of the arm just above the wrist in 1902 and 1905, followed by deformity and limitation of movement at the right elbow, but no serious disability. In 1929 weakness and pain in the arm developed; examination revealed swelling of the forearm and a rarefying process was demonstrable in the ulna. Resection was done and the tissue diagnosed as "mesenchymal endothelioma." A recurrence appeared in 1934 and diagnosis of the resected tissue was "endothelial bone tumor, probably angiosarcoma." Subsequent amputation, two months later, was necessary. The patient has remained in good health since.

Review of all the microscopic sections by the Bone Sarcoma Registry led to an agreement that the neoplasm was an adamantinoma. IVAN J. MILLER

THE GENITO-URINARY TRACT

Papilliferous Carcinoma in a Double Kidney. R. Shackman and B. R. Billimoria. Brit. J. Surg. **30:** 82–84, July 1942.

Cystoscopic examination for hematuria in the case here recorded revealed two ureteral orifices on the left side with blood coming from the lower orifice. A papilloma about a quarter of an inch in diameter was seen just above the region of the double ureteral openings and was fulgurated. A retrograde pyelogram revealed a double left ureter and pelvis with irregular mottled filling defects of the upper pelvis and upper

ureter suggesting a papillomatous neoplasm. Nephrectomy was performed and a papilloma was found involving the pelvis and upper ureter. It had produced obstruction with resulting hydronephrotic atrophy of the upper half of the kidney. The lower half of the kidney and its ureter were entirely normal.

This type of tumor is the one most commonly found in the renal pelvis and frequently spreads to involve the ureter and bladder. The authors refer to a published series of 46 cases, with extension to the ureter in 23, and to the ureteric orifice and bladder in 17.

MAX CLIMAN, M.D.

Primary Papillary Carcinoma of the Ureter, with Report of a Case. A. J. Scholl and V. J. Gallagher. California & West. Med. **57:** 180–184, September 1942.

A case of papillary carcinoma of the ureter occurring in a 35-year-old man is reported by the authors. Cystoscopy revealed inflammation in the region of the right ureteral orifice and indigo-carmin injected intravenously was returned in reduced amount from the right ureter. A catheter encountered obstruction 8 cm. above the orifice of the ureter at the level of the iliac crest, where it turned lateralward. At the point of turning the injected opaque medium disclosed a dilatation with a large filling defect above it. No fluid could be forced beyond this point. Intravenous pyelograms revealed good renal function on both sides. The right renal calices, pelvis, and upper third of the ureter were enlarged and the ureter was tortuous. The middle third of the ureter was considerably dilated, with a 5-cm. filling defect in the center of the dilatation. A film taken with the patient upright showed the dilated area to be freely movable. A diagnosis of ureteral tumor was made and the kidney and ureter were removed. Because of the tendency of papillary tumors to involve the distal ureter and bladder by implantation, the segment of the bladder containing the mural portion of the ureter was fulgurated. The growth was of a low degree of malignancy. A postoperative course of x-ray therapy was given to the involved area, and the patient was symptom-free eight months later.

The literature of ureteral tumors is briefly reviewed. Foord and Ferrier (J. A. M. A. **112:** 596, 1939) collected 139 cases. In 100 surgical cases, there was a postoperative mortality of 34 per cent. Immediate mortality in one-stage nephro-ureterectomies was 40 per cent. The authors are of the opinion that the high mortality rate is due to late diagnosis and over conservative therapy. MAURICE D. SACHS, M.D.

Perinephric Abscess. F. A. Simeone. Arch. Surg. **45:** 424–442, September 1942.

Perinephric abscess is a suppurative inflammatory lesion of the fibro-fatty bed surrounding the kidney in the lumbar gutter. It is always secondary to infection elsewhere. It may be simple, reaching the region from a distant focus by the blood or lymph stream, or complicated, reaching the region by direct extension secondary to pyelonephritis or pyonephrosis or from some other nearby focus. The condition is not rare; most cases occur between the ages of twenty-five and thirty-five. The ratio of males to females was 2.5 to 1 in the 66 cases here reported. Simple abscess is about twice as common on the right side as on the left; the complicated type was equally distributed.

Diagnosis is reached by considering all the clinical and laboratory evidence. The early history may be vague, with complaints of a "below par" feeling, anorexia, fatigability, and night sweats. Chills and fever are common. Antecedent infection is observed in about half the simple abscesses. Pain is the most consistent symptom and is generally located in the loin and is not colicky. Nausea and vomiting are common only in cases of abscess secondary to chronic renal disease. Urinary symptoms are unusual. Loss of weight is rapid.

On physical examination the patient appears acutely ill and toxic, and may even be in coma. The temperature may be from 102° to 106° F. orally. Spiking occurs in the earlier stages only. The pulse is often rapid. Tenderness was the most common finding, located at or near the costovertebral angle. Spasm was present in the flank or costovertebral angle. While visible swelling of the loin was present in about half the cases, a mass was palpable in only some of these. Diaphragmatic elevation, scoliosis, and psoas spasm may be present, but were less common than has been commonly believed.

None of the accepted roentgen signs is pathognomonic. In about a third of cases the x-ray findings are normal. Indistinctness of the psoas shadow and diaphragmatic elevation are the most frequent signs. Pyelograms sometimes show distortion of the calices or displacement or rotation of the kidneys.

Urinalysis showed abnormalities least frequently in patients with simple abscess and without involvement of the kidney itself. Hypochromic anemia was common. The white count was elevated, usually between 10,000 and 20,000, and 85 to 90 per cent of the cells were polymorphonuclears. Bacteria could usually be recovered from perinephric pus in almost pure culture. *Staphylococcus aureus* was the most common organism, with *Bacillus coli* second. Blood culture was positive only in the presence of renal involvement.

Occasionally recovery occurs without treatment. Most patients recover with simple incision and drainage if there is no carbuncle of the kidney. In the latter case, nephrectomy is sometimes required, as it is in many of the complicated cases. In the simple cases no mortality due to the abscess or treatment was observed; in the complicated groups, mortality ranged from 14 to 50 per cent, depending on the type of complication.

Three factors tend to promote complications and delay convalescence: (1) failure of early diagnosis; (2) the architecture of the region, which favors neither localization nor drainage; (3) the poor general condition of the patient. LEWIS G. JACOBS, M.D.

Traumatic Rupture of the Urethra. M. Silverstone. Brit. J. Surg. **30:** 70–74, July 1942.

Ruptures of the urethra are described as anterior when they occur in front of the triangular ligament—usually in the bulb, rarely in the penile urethra—or posterior when they occur behind the triangular ligament, in the membranous or prostatic urethra. The latter are often associated with a fracture of the pelvis.

Three cases are reported, all of which were caused by direct trauma to the perineum. In all 3 cases suprapubic cystotomy was performed, which renders the finding of the proximal end of the urethra a simple matter. An indwelling urethral catheter was used in each case. Urethrograms made at the end of treat-

ment showed narrowing of the bulbous urethra in one case; in the other two the appearance was normal.

The author says of treatment:

"It is suggested that ruptures of the anterior urethra should be treated by suprapubic cystotomy, perineal section with suture of the roof, and packing of the perineal wound, urine draining only through the suprapubic wound.

"Ruptures of the posterior urethra should have a suprapubic cystostomy, together with splinting of the rupture by an indwelling catheter.

"The incidence of strictures following rupture of the urethra is increased by local sepsis. This may possibly be minimized by chemotherapy. The severity of the local damage is also a factor in its production."

MAX CLIMAN, M.D.

RADIOTHERAPY

MALIGNANT NEOPLASMS

Management of the Cancerous Patient Under Radiation Therapy. C. B. Peirce. Canad. M. A. J. **47:** 119–123, August 1942.

With emphasis on the necessity for close co-operation between the radiologist and attending physician or surgeon in management of the cancer patient, the author discusses several of the more outstanding problems which arise. He divides his discussion into two parts; general management and specific radiation management.

The necessity for a thorough clinical examination of every patient is stressed since cancer is often discovered incidentally or is overlooked for lack of complete examination. Supportive treatment must be both psychological and physical. The physician has to combat the general consideration of cancer as a hopeless disease and educate both the patient and family to the fact that something can be done. While the percentage of cures based on ten- to fifteen-year survival rates is not high, many cases are amenable to palliation. Physical factors in treatment stressed are: conservation of energy; maintenance of fluid intake either orally or by intravenous fluid administration, and whole blood transfusion; adequate vitamin B complex in the diet or, in the case of patients receiving radiation therapy, 50 mg. of thiamine and 500 mg. nicotinic acid per day in addition to an adequate diet. Several therapeutic agents for relief of pain are discussed, including roentgen therapy plus additional sedatives, as acetylsalicylic acid, cobra venom, and occasionally, in the later stages, nerve block or cordotomy. Intercurrent infection is to be avoided. The author warns, however, that there is clinical evidence that sulfonamides and irradiation are incompatible.

In the discussion of specific radiation management, it is pointed out that the effect of roentgen or radium radiation is always damaging to a certain extent and that repeated small doses may be more damaging than several large ones. Normal cells, however, possess the ability to recuperate, while the cancer cell either dies or becomes senescent. Reaction must be produced in normal skin or tissues in order to be sure of reaction in the diseased structures. Adequate irradiation may require thirty to forty-two successive treatments over a period of at least six weeks. The skin reaction and mucous membrane reaction will appear between the fourteenth and twenty-first days. With proper care the tissues will undergo repair and the patient may expect a soft, pliable skin. Care of the skin includes prevention of chafing and rubbing and use of borated talcum to keep the area dry.

It is the author's opinion that surgical procedure should either precede irradiation or be delayed until at least two months after irradiation is completed. Preoperative irradiation is considered more valuable than postoperative; the primary growth is more readily operable following irradiation and cells accidentally disseminated during operation will be less viable.

MARIE R. CONNELLY, M.D.

Contact X-Ray Therapy. W. L. Kirby. South. M. J. **35:** 809–814, September 1942.

So-called "contact therapy," or "Chaoul therapy," calls for an anode skin distance of 2 to 10 cm., with only 50 or 60 kv. The author, using a conventional machine with housing permitting a focal skin distance of 6 cm., and 80 kv. at 5 ma., with an output of 940 r per minute, is able, practically, to parallel the desirable features of a Chaoul apparatus.

A basal-cell cancer is screened with 1-mm. lead foil and given 6 to 8 treatments, usually of 940 r each, with intervals of one day between treatments. Paradoxically the larger the area the smaller the dosage required, because of backscatter. After the last treatment a pronounced erythema is usually evident. A moist epidermitis appears one week later and persists from one to three weeks. The author also describes his technic for plantar warts and angiomas.

A table of comparative depth dosage with different methods of irradiation is included. According to this, with contact therapy with 80 kv., inherent filtration, 0.7 mm. Al half-value layer, and 6 cm. distance, the dose at 1 cm. depth is 38 per cent of that at the surface. With surface application of radium the 1 cm. depth dose is 29 per cent. Despite the low kilovoltage in the author's technic the intensity of irradiation at the surface, expressed in r, is greater than with higher voltage at an increased distance, as shown in the following table.

	100 kv.—20 cm.		50 kv.—6 cm.	
	%	r	%	r
Surface dose	100	4,363	100	8,571
1 cm. depth	55	2,400	28	2,400
2 cm. depth	32.6	1,423	11.4	977
4 cm. depth	14	611	3.8	325
Radiation absorbed in 1 cm. of tissue	45	1,963	72	6.171

Over a period of seven years, late roentgen ulcers and necrosis of cartilage have never been observed with the author's method. In cancers of the lower lip dosages of 900 to 1,200 r are administered daily for eight days, giving 7,200 to 9,600 r. The cosmetic results are satisfactory.

It is concluded that the conventional shockproof superficial therapy unit which will permit a focal skin distance of 5 to 8 cm. is satisfactory for the dermatologist who has little need for intracavitary irradiation.

MAX MASS, M.D.

Cancer of the Nasal Cavity. W. S. MacComb and H. E. Martin. Am. J. Roentgenol. **47:** 11–23, January 1942.

Cancers of the nasal cavity—to be distinguished from the naris, which is merely the opening into the cavity—are defined as those growths arising in that portion of the nasal passage which lies between the anterior naris (nostril) in front and the posterior naris (choana) behind, bounded by the septum, the lateral wall, and the floor of the nasal fossa. Sixty-five cases seen at Memorial Hospital (New York) form the basis of this paper. The incidence in that institution has been approximately 1 among every 150 patients admitted for cancer of the upper respiratory and alimentary tracts.

There were 41 males and 24 females in the series recorded, with the largest number of cases in the sixth decade. Forty-seven of the tumors were classed as epithelial, 11 as glandular (adenocarcinoma), and 7 as mesodermal (sarcoma). Growth is usually slow and pain is due to pressure or erosion of the bone. Eventually the openings of the paranasal sinuses are blocked and a pansinusitis results. If no relief is obtained from this condition, the infection may extend into the cranial cavity. Many of the tumors reach the orbital cavity directly, by erosion of the lateral wall of the nose. This occurred in 50 per cent of the present series before admission. Extension of the disease into the orbit may cause exophthalmia or diplopia or both. Invasion through the ethmoids to the floor of the orbit was demonstrated by roentgen examination in 16 cases (25 per cent) of the present series on admission and in an additional 9 (14 per cent) at some time during the course of the disease.

Metastasis is less frequent than might be expected. Although the average duration of symptoms in the authors' series was eleven months, only 8 patients were found to have metastases on admission. In 11 others metastases appeared subsequently.

The transitional-cell epitheliomas, lympho-epitheliomas, and anaplastic epidermoid carcinomas are responsive to irradiation. The present practice at Memorial Hospital is to treat these with high-voltage roentgen rays: 200–250 kv., 15–30 ma., 0.5–1.5 mm. copper and 1.0 mm. aluminum filter. Daily treatments are given over a period of approximately three weeks, the daily dose varying with the size of the field. For a field 5 cm. in diameter, a total dose of 4,000 to 5,000 r is delivered. If feasible, a peroral portal should be used as well as an external skin portal. The area to be irradiated should include the nasal cavity, the antrum, the ethmoidal region, and the floor of the orbit on the affected side and, in some cases, the frontal sinus as well. It is important that the medial border of the field should extend beyond the mid-line of the nasal septum.

The more radioresistant lesions, including the low-grade squamous carcinomas, adenocarcinomas, angiosarcomas, and melanomas, are treated surgically, with postoperative high-voltage irradiation (200–300 r daily for a total of 2,500–3,000 r over a circular field 6–7 cm. in diameter).

Recurrences following external irradiation may be treated by interstitial or intracavitary irradiation. When the original treatment was surgical small recurrent growths may be cauterized and more extensive lesions implanted with gold-filtered radon seeds. Cervical metastases are treated as in intra-oral cancer.

Thirty-seven patients were observed by the authors for five years or more. Of these, 2 died of other causes after a year's freedom from cancer; 26 died with cancer; 1 was alive with recurrence; and 8 were free of disease.

Radiation in the Treatment of Genital Cancer. H. E. Schmitz. West. J. Surg. **50:** 445–448, September 1942.

The author describes the following routine technics for radiation therapy in carcinoma of the female genitalia:

In *carcinoma of the cervix* a preliminary course of deep x-ray therapy is given only in cases of large proliferating growths. If pyometra is present, this is surgically drained before instituting treatment. Cavitary radium therapy is then given, using 50 mg. radium element filtered by 2.0 mm. brass and 2.0 mm. Para rubber. A total dose of 4,500–4,800 mg. hours is given in three insertions at eight-day intervals. This is followed by deep x-ray therapy, with the following factors: 800 kv.p., 10 ma., 10 mm. Cu filter, 70–86 cm. distance, 10 to 20 sq. cm. fields, H.V.L. 8.2 mm. Cu, 36 r/min. (44 r/min. with backscatter). Two fields are usually sufficient, pubic and sacral, 4,000 r units per field being given in ten doses, forty-eight hours apart. The tumor dose is approximately 4,000 r (10 cm. depth dose = 56 per cent). Routine cystoscopic and proctoscopic studies are made and if tumor invasion is noted, radium therapy is omitted, as it may hasten fistula formation.

Carcinoma of the uterine body is also given combined treatment. A Y-shaped radium applicator is used, the arms being separated by a set screw; 50 mg. are used in each arm of the Y for fourteen hours. Three applications are given eight days apart, totalling 6,300 mg. hours (approximately 4 E.D.). X-ray therapy is then given, using four fields so as to include the parametria and regional lymph nodes. The technic is as described above. After the irradiation effect has disappeared from the tissues (eight to ten weeks) total hysterectomy is done. In the last 23 cases of fundal carcinoma seen by the author, only one showed microscopic evidence of active tumor cells at operation.

Carcinoma of the ovary is best treated surgically. X-ray therapy as outlined above is used as a routine postoperative measure. In inoperable cases it is the only effective palliative measure. If ascites is present, it is advisable to remove fluid before administering x-ray.

SIMON POLLACK, M.D.

Errors in the Treatment and Management of Carcinoma of the Cervix. A. W. Diddle. West. J. Surg. **50:** 449–451, September 1942.

In reviewing 885 cases of carcinoma of the cervix seen at University of Iowa Hospitals from 1926 to 1942, it was found that 152 had inadequate or improper treatment prior to hospital admission. Of 107 of these patients who were followed for five years, only 8 survived without recurrence.

The author's conclusion points to the necessity for complete examination and biopsy in every suspect case,

which should obviate such treatments as douches, cervical cauterization, subtotal hysterectomy, and inadequate radiation therapy, and lead to adequate therapy with the least procrastination.

SIMON POLLACK, M.D.

Some "Don'ts" in the Treatment of Carcinoma of the Corpus. E. J. De Costa. West. J. Surg. **50:** 452–453, September 1942.

The following cautions are given by the author, to obviate mistakes in handling corpus uteri carcinomas:

(*a*) Never fail to do a diagnostic curettage in the presence of abnormal uterine bleeding. Corpus carcinoma may exist even when fibroids, ovarian cysts, or other benign conditions are also present.

(*b*) Don't insert radium without ascertaining the length of the uterine canal, so that a proper-sized tandem may be used in radium application.

(*c*) Don't fail to do a thorough bimanual examination on every patient before operation; examine the parametria and vaginal vault carefully for possible tumor extension.

(*d*) Don't operate without a complete general examination, to make sure that the patient is not debilitated from some systemic disease.

SIMON POLLACK, M.D.

Carcinoma of the Cervical Stump. S. T. Cantril and F. Buschke. West. J. Surg. **50:** 454–457, September 1942.

The authors have collected 14 cases of carcinoma of the cervical stump from a total of 223 cervical carcinomas seen at the Swedish Hospital, Seattle, Washington, in 1935–41. This is an incidence of 6 per cent. Half the cases were in stages I and II, showing that these women were more prone to pay attention to early signs and report for medical care.

The authors prefer to treat these cases by intravaginal and paracervical radium application, using 30–40 mg. with 1.0 mm. platinum filter and a rubber container, giving a minimum of 4,000 mg. hours in a continuous application. In later cases, the dosage has been increased to 6,000–7,000 mg. hours in two applications. The rectal mucosa is carefully watched for reaction. After completion of radium therapy external x-ray therapy (800 kv.) is given, a total of 10,000–12,000 r (including backscatter). In one instance a bulky cauliflower mass received 7,850 r intravaginally before the radium application.

Of 11 patients treated, 7 are well to date. This compares favorably with other series of stump carcinomas reported. The authors do not feel that total hysterectomy should be done in every case in which removal of the corpus uteri is required, but suggest a more careful study preoperatively, especially microscopic examination of biopsy and curettage sections. Even if carcinoma is excluded, total hysterectomy should be done when the cervix is badly eroded or lacerated.

SIMON POLLACK, M.D.

NON-NEOPLASTIC CONDITIONS

Irradiation in the Treatment of Limb Asymmetry: Report of Case. I. I. Kaplan. Arch. Pediat. **59:** 559–564, September 1942.

Kaplan reviews the evolution of arrest in bone growth by irradiation of the epiphyseal zones, pointing out that the need for such arrest most often arises in connection with poliomyelitis. The normal leg continues to grow, while the affected limb suffers a growth arrest: therapy, therefore, may be directed toward retarding the growth of the intact limb.

In 1930 Desjardins reported retardation of bone growth in a nine-year-old child treated for bone tumor. Stevens, in 1935, reported adverse effects on bone following x-ray therapy of a nevus. Retardation of bone growth was also noted in experimental work on animals. In 1933 Brooks and Hellstrom found that irradiation of the epiphyses interfered with bone growth, and in 1939 Engel and Richer suggested the possibility of correcting deformities of the spine by inhibiting the epiphyseal growth on one side to counteract the deformity on the other.

The x-ray effect on an epiphysis is one of sclerosis; the soft cancellous tissue is replaced by osteosclerosis and calcification.

Kaplan reports a case in which the lower epiphysis of the left femur in a nine-year-old boy was treated. Factors were: 200 kv., 0.5 mm. Cu filter, plus 1.0 mm. Al, 50 cm. distance with 6 cm. fields over the anterior and posterior left lower femoral epiphysis. Treatment was given daily, 150 r each on alternate areas, a total of 1,500 r being delivered to each area from Jan. 29, 1940, to Feb. 27, 1940. Following treatment on Feb. 27, 1940, a roentgenogram showed "definite evidence of progressive ossification of the epiphyseal plate of the lower extremity of the left femur."

In June of the same year another course of therapy was administered: five treatments, totalling 750 r to each area.

On admission, the measurements of the two legs were as follows: left, 30 inches; right 27.5 inches. In May 1942 the measurements were: left, 31; right 29.25. Standing barefoot the boy was now able to reach the ground with the ball of the right foot with toes completely on the ground. X-ray examinations showed further evidence of epiphyseal sclerosis.

PERCY J. DELANO, M.D.

RADIATION REACTIONS

Lesions Produced in the Gastro-Intestinal Tract by Irradiation. General Review with an Illustrative Case Report. R. M. Mulligan. Am. J. Path. **18:** 515–526, May 1942.

To a review of the literature, which includes brief case histories and experimental studies, the author adds a case of injury to the gastro-intestinal tract as a result of radiotherapy for a cervical squamous-cell carcinoma. In a period of two weeks a dose of 4,200 r was given through 10 anterior and 11 posterior pelvic fields (20 by 20 cm. portal, 215 kv., 15 ma., Thoraeus filter, 50 cm. skin-target distance, 9 minutes per 200 r, and no more than 200 r over any portal).

Nausea, vomiting, and diarrhea developed during the treatment, and about two weeks after its completion the patient died. At autopsy the striking feature was the destruction of the intestinal epithelium. In addition to this the author directs attention to the more

distant effect of irradiation on the blood vessels of the intestine, with thrombosis and infarction of the whole thickness of its wall, as well as the sequelae of ulceration, perforation, abscess formation, fistulae, peritonitis, fibrosis, stenosis, and intestinal obstruction.

A bibliography is included and photomicrographs are reproduced.

Pathology and Pathologic Diagnosis of Radiation Lesions in the Gastro-Intestinal Tract. S. Warren and N. B. Friedman. Am. J. Path. **18:** 499–507, May 1942.

As the title indicates, this is a pathologic study of radiation lesions of the stomach and intestine. It is based on 38 selected cases showing severe reaction, in which the details of radiotherapy were known. These cases are presented in tabular form. The lesions consisted of ulceration, sclerosis, and combinations of the two. Sometimes a segment of intestine was uniformly involved; sometimes the process was focal, with single or multiple lesions.

The bowel wall was usually thickened and indurated, with the serosa opaque and showing prominent telangiectasia. The mesentery, particularly at its point of attachment, was frequently similarly involved. The mucosa rarely appeared entirely normal, but usually, even in non-ulcerated lesions, atrophy and fixation to the mucosa were seeen. The degree of ulceration ranged from confluent, irregular, superficial erosions to deep, punched-out ulcers. The persisting mucosa was irregularly heaped up and nodular in the former, while discrete ulcers were very sharp-edged. Telangiectasia occurred especially at the edges of ulcerated areas. Stenosis was sometimes due to diffuse sclerosis with general constriction of a segment, and sometimes to formation of a stricture at a site of ulceration.

Secondary changes, such as inflammatory reactions related to penetrating or perforating ulcers and fistulae, were evident. Exudation of fibrin, fibrinopurulent membranes, and adhesions were encountered. Necrosis was a part of most reactions.

In biopsy specimens the most significant primary findings are hyalinization of the connective tissue, abnormal fibroblasts, telangiectasia, and hyaline degeneration of vessel walls.

The secondary diagnostic features include endothelial abnormalities, phlebosclerosis, changes in the muscle fibers, and epithelial alterations. Atypical endothelial cells are seen far less frequently than the almost invariably present altered fibroblasts, but when they are seen, they lend support to the diagnosis. Phlebosclerosis is an important part of the vascular change, but is not a specific finding. Nor are the epithelial changes characteristic, though swollen nuclei with prominent "owl's eye" nucleoli and pronounced mucous change are suggestive.

Evolution of Experimental Radiation Ulcers of the Intestine. N. B. Friedman and S. Warren. Arch. Path. **33:** 326–333, March 1942.

The evolution of intestinal radiation ulcers in rabbits was studied by observing the pathologic changes produced in the intestines by a course of roentgen ray treatments. Observations were made during the period of irradiation and at regular intervals thereafter for six months. It appears from these studies that the radiation effect lays the ground work upon which the ulcers eventually develop. Mucosal changes begin during the first few days following irradiation. Subsequently regenerative and reparative processes are observed, but in certain regions these are inadequate for complete restoration of the mucosa and here ulcers develop as a result of mechanical trauma and subsequent infection. Thus, ulceration was most frequent in the colon, where repair is less active than elsewhere in the intestinal tract and mechanical trauma and bacterial action are more common.

Radiation Reactions. B. W. Windeyer. Brit. J. Radiol. **15:** 236–237, August 1942.

The treatment of radiation reactions causing desquamation may be divided into two stages. In the first stage, before desquamation occurs, the skin should be kept dry by the application of alcohol and powders. Greasy dressings should be avoided. In the second stage, after desquamation has started, two main points are to be considered: control of infection and elimination of trauma. The infection may be controlled by the use of 20 per cent sulfathiazole ointment in a base miscible with water, and by irrigations with electrolytic sodium hypochlorite. To protect from trauma the area should be covered with oiled silk sheeting.

Intra-buccal necrosis is difficult to treat. Irrigation with 2.5 per cent electrolytic sodium hypochlorite will reduce infection, allay pain, and aid in the separation of sloughs.

No satisfactory method of controlling connective-tissue reactions, such as those seen in the treatment of carcinoma of the larynx, has been found.

SYDNEY J. HAWLEY, M.D.

Control and Treatment of Radiation Reactions. D. W. Smithers. Brit. J. Radiol. **15:** 233–236, August 1942.

Two types of radiation reaction are considered: (1) general reactions, or "x-ray sickness," consisting in nausea, vomiting, malaise, and fatigue; (2) alterations of the blood count. An attempt was made to correlate the general reaction with the integral dose in "megagramme roentgens" as calculated by Mayneord's method, and with the rate of application, but no correlation was found.

From this study it appears that: (1) many patients do not develop x-ray sickness even following large integral doses daily; (2) x-ray sickness varies with the individual, both as to severity and time of onset; (3) this variation has something to do with the patient's mentality, though this may not be the sole or even the major consideration; (4) reactions are apt to be less in patients in good general health; (5) the symptoms depend on the energy absorbed and the part of the body treated; (6) they also depend on the size of the daily dose and the total treatment time; (7) in cases of malignant disease they are related to the size and radiosensitivity of the tumor.

Histaminase and vitamin B have been tried for the treatment of general reactions without consistent results.

The author devotes only a brief space to the effect of radiation on the blood count. The administration of vitamin C in large doses, with soda bicarbonate, helps to prevent leukopenia.

SYDNEY J. HAWLEY, M.D.